The Aviation Historian®

The modern journal of classic aeroplanes and the history of flying

ORIENT EXPRESS

indonesia & the convair 990

ISSUE 23

BUCCANEER
CELEBRATION BOOK LAUNCH

Join us to mark the 60th Anniversary of the first flight of Blackburn NA.39 XK486, the prototype Buccaneer at Bruntingthorpe Proving Ground.

The Aviation Bookshop - at the service of all aviation enthusiasts since the 1940s

EXCLUSIVE BOOK SIGNING

MEET THE AUTHOR WG CDR DAVID HERRIOT AT THE AVIATION BOOKSHOP STAND

Saturday 28th April 2018, from 12 noon, Bruntingthorpe Proving Ground, during The Buccaneer Aviation Group's Open Day (admission applies).

£25 • PRE-ORDER YOUR COPY NOW!

SPRING BOOK SALE

Friday 20th April	Friday 9am – 5pm
Saturday 21st April	Saturday 9am – 5pm
Sunday 22nd April	Sunday 10am – 4pm
Monday 23rd April	Monday 9am – 5pm

Discount applies to shop visitors and orders made by phone, email or via our website (please quote 'SPRING' when placing order).

25% DISCOUNT OFF ALL NEW & SECONDHAND BOOKS AND MODEL KITS

The Aviation Bookshop, 31-33 Vale Road, Royal Tunbridge Wells, Kent, TN1 1BS, ENGLAND
01892 539284 (international: +44 18 92 53 92 84)
info@aviation-bookshop.com
www.aviation-bookshop.com

Payment Methods
Cheques made payable to The Aviation Bookshop
or you can pay via PayPal using info@aviation-bookshop.com
All major credit cards accepted

UK Postage & Packing
Postage to all UK addresses £5.00

Overseas Delivery Charges
Postal charges are made at cost price to The Aviation Bookshop.
We are unable to detail exact postal charges as orders are treated individually and the applicable charge is calculated accordingly.

NEW! Secondhand Booklist
Please contact us for our latest secondhand booklist.

Follow us on twitter for events, news and special offers @Avbookshop

Please quote **BUCCANEER** when responding to this advert.

Information published here may be subject to change.

Published quarterly by:
The Aviation Historian
PO Box 962
Horsham RH12 9PP
United Kingdom

Subscribe at:
www.theaviationhistorian.com

ISSUE NUMBER 23
(published April 15, 2018)

Published quarterly by *The Aviation Historian,*
PO Box 962, Horsham RH12 9PP, United Kingdom

ISSN 2051-1930 (print)
ISSN 2051-7602 (digital)

Printed in the UK by
The Magazine Printing Company
using only paper from FSC/PEFC suppliers
www.magprint.co.uk

The Aviation Historian®
The modern journal of classic aeroplanes and the history of flying

Editor's Letter

ON APRIL 1, 1918 — All Fool's Day, as more than a few politicians, paymasters and pilots no doubt noted at the time — the Royal Air Force was established as an independent air arm. Naturally, the storied history of the RAF and its many battle honours and achievements will be trumpeted far and wide during this centenary year; but, in true *TAH* style, we wanted to take a closer look at the reasoning behind its establishment in the first place. Enter Greg Baughen, whose examination of why the RAF came into being — the shadow of aerial bombing and "total war" — offers some thought-provoking insights into how a "new broom sweeping clean" led, in this case, to the wholesale dumping of some invaluable lessons learned during four hard years of war.

The establishment of a very different sort of air force is detailed in João-Paulo Moralez and Vatche Mitilian's article on the Lebanese Air Force's DIY development of Bell "Huey-bombers", in which parts from a 1950s jet fighter were grafted on to a combat helicopter emblematic of the 1960s to fight a war in 2007. Necessity truly is the mother of invention!

While preparing this issue, we were deeply saddened to learn of the death of aviation enthusiast extraordinaire Mike Hooks in January. Mike was the very definition of what I described in the first *TAH* Editor's Letter as aviation's "true believers", and his tireless passion for all things aeronautical, often tinged with more than a hint of mischief and iconoclasm, will continue to inspire us here at *TAH*. We pay tribute to our longstanding friend and former colleague with a dazzling collection of the magnificent photographs he took over the course of a lifetime in aviation. As the man himself would say when settling in for a good read: "Woof!" (see page 32!)

FRONT COVER ***Ready, jet set, go! The first of Garuda Indonesian Airways' Convair 990As, PK-GJC, named*** **Majapahit,** ***looking sleek over California before delivery in late 1963.*** SAN DIEGO AIR & SPACE MUSEUM

BACK COVER ***The futuristic — but aerodynamically troubled — Lockheed P-38 Lightning. See pages 18–30 . . .*** PHILIP JARRETT COLLECTION

CONTENTS Issue No 23

AIR CORRESPONDENCE

Letters to the Editor

Illusions and injustices

SIR — Regarding *Here Come the Vixettes* in *TAH21:* as author Matt Willis says, Abbotsinch made a number of weird aircraft. The accompanying photograph shows a Sea Venom derivative in July 1961. It's not my photo, possibly one by Stewart Waring. I believe these aircraft were created for the open days and were capable of moving under their own power, runways only.

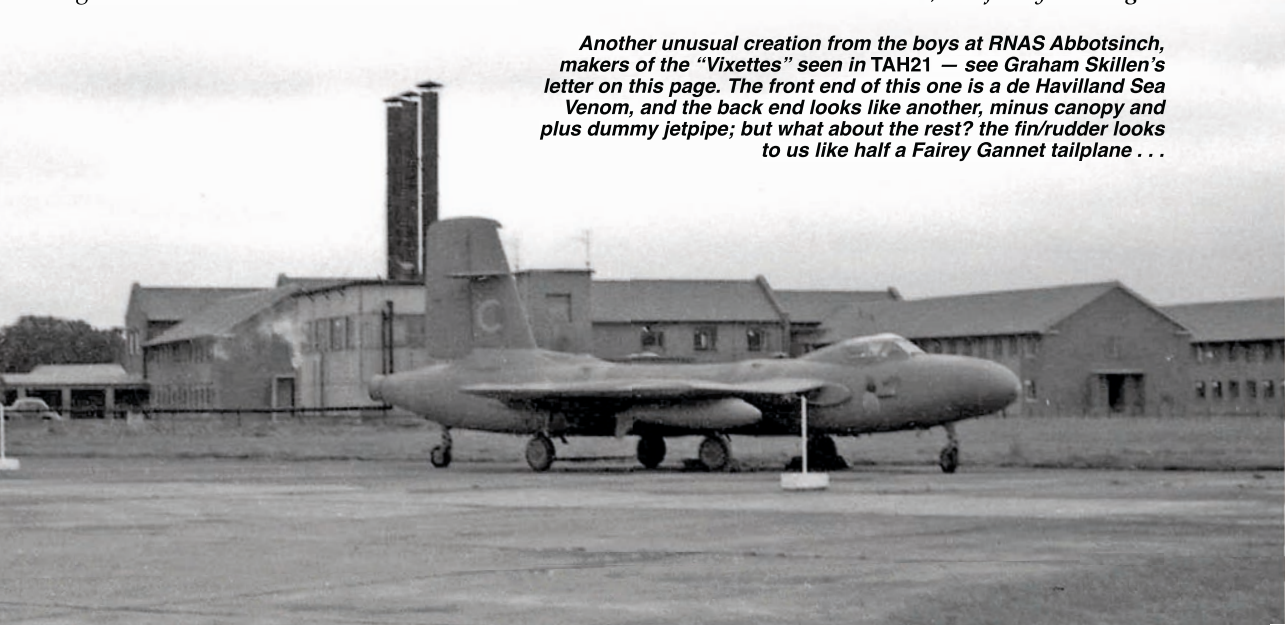
Regarding *Shrinking Pains* in the same issue: I fear Chris Gibson is a bit hard on Shorts. To say that the company's work on the Seamew had not inspired confidence is not really fair. To specify a single-engined over-water-role aircraft wasn't Shorts' fault, nor a spec requiring a stall speed below 40kt, I believe, and a dive speed up in the hundreds, nor changing the requirement with half the aircraft built. A typical ministry travesty, with which Shorts had to work.

While still at school I remember watching the Seamews being tested over Belfast, involving a lot of spinning and diving. Chris also pans the Belfast, again a design compromised by the powers-that-be, forced as it was to use the Britannia wing and inadequate engines. With the benefit of hindsight have you noticed the geometric similarities between the Airbus A400M Atlas and the Belfast, the subtle difference being the 400's 11,000 h.p. compared to the Belfast's 5,700 h.p.? If only we'd had that in 1964! The initial production order for Belfasts was for 30 aircraft, if I remember correctly, and Shorts did have a [Lockheed] C-141 lookalike version, which the ministry spurned.

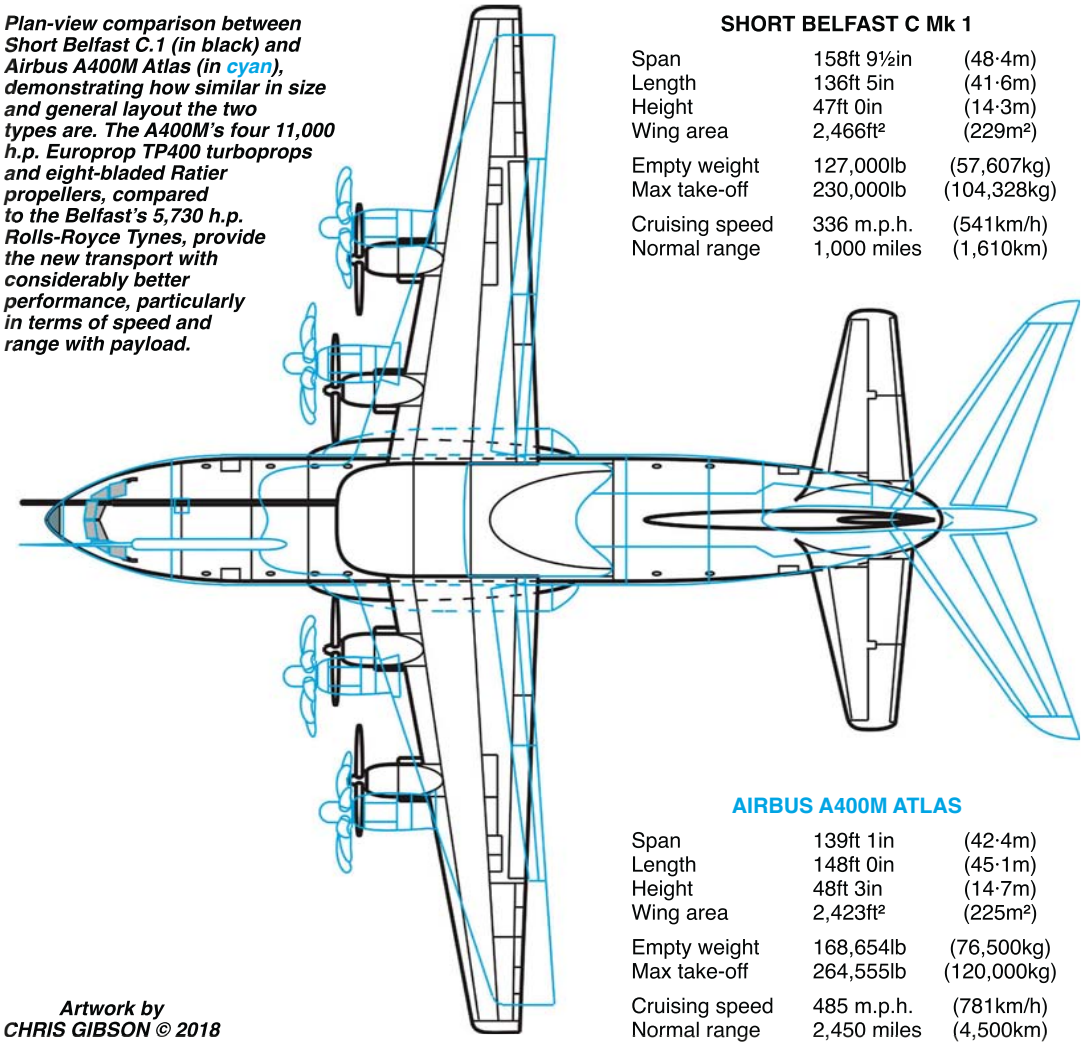
Graham Skillen *North Cheriton, Somerset*

Chris Gibson responds: ***Graham is quite correct, I was hard on Shorts, but realistic. When examining the UK aviation industry, I removed the Gunstonian rose-tinted spectacles a long time ago. Graham is also correct on ministry specifications, with M.123 a particularly odd one that typified the state of flux extant in the ministries at the time. I could argue that M.123 was a spec for a fixed-wing wing helicopter, but that would be arrant nonsense. The resulting Seamew was known for difficult handling and I can only assume that the manœuvres Graham witnessed were at safe altitudes.***

While the Britannic 1 was to use it, Britannic 3A, the Belfast, was not forced to use the Britannia wing, but a thinner design with under- rather than overwing engines. The Air Staff and Air Ministry viewed the propeller-driven Britannic as archaic; "as funny-looking



Another unusual creation from the boys at RNAS Abbotsinch, makers of the "Vixettes" seen in* TAH21 *— see Graham Skillen's letter on this page. The front end of this one is a de Havilland Sea Venom, and the back end looks like another, minus canopy and plus dummy jetpipe; but what about the rest? the fin/rudder looks to us like half a Fairey Gannet tailplane . . .



Plan-view comparison between Short Belfast C.1 (in black) and Airbus A400M Atlas (in cyan), demonstrating how similar in size and general layout the two types are. The A400M's four 11,000 h.p. Europrop TP400 turboprops and eight-bladed Ratier propellers, compared to the Belfast's 5,730 h.p. Rolls-Royce Tynes, provide the new transport with considerably better performance, particularly in terms of speed and range with payload.

Artwork by CHRIS GIBSON © 2018

SHORT BELFAST C Mk 1

Span	158ft 9½in	(48·4m)
Length	136ft 5in	(41·6m)
Height	47ft 0in	(14·3m)
Wing area	2,466ft²	(229m²)
Empty weight	127,000lb	(57,607kg)
Max take-off	230,000lb	(104,328kg)
Cruising speed	336 m.p.h.	(541km/h)
Normal range	1,000 miles	(1,610km)

AIRBUS A400M ATLAS

Span	139ft 1in	(42·4m)
Length	148ft 0in	(45·1m)
Height	48ft 3in	(14·7m)
Wing area	2,423ft²	(225m²)
Empty weight	168,654lb	(76,500kg)
Max take-off	264,555lb	(120,000kg)
Cruising speed	485 m.p.h.	(781km/h)
Normal range	2,450 miles	(4,500km)

as those four-funnelled destroyers". They wanted a fast transport such as the VC10 Military Transport or, their preference, the HP.111. Shorts did propose jet transports: Britannic 5 and 6 with the VC10 wing and the SC.5/40, /41 and /45 with wings **similar** *(Shorts' emphasis) to the C-141. Of course, by the time the Belfast was being built, there was no need for it as there was no requirement to move equipment to the Far East — which brings me to the core of my argument: politics.*

Shorts is one of the more interesting creatures in the British aviation menagerie, but requires a bit more realism in its study. Nobody could deny that Shorts was a political football, mainly because the Ministry of Supply held 72 per cent of the company and it was apparently to be kept in business at all costs. For example, Saro's flying-boat to meet R.112 was deemed the best proposal, but MoS policy was that Saro was to be allowed to go under, with one reason being that its coastal plant was deemed more vulnerable to attack than the Shorts factory! The MoS had given Shorts the contract to develop its PD.2 for R.112 but the Air Staff and Air Ministry were particularly miffed because Shorts drew up a PD.2 design more as potential airliner than warplane, so the company was sent back to the drawing-board.

I have indeed noticed the parallels in the Belfast and Atlas, and, as Graham points out, the engines make the difference. The Belfast SC.5/21 was proposed as a "stractical" transport, able to deliver materiel to austere strips near the front. That is exactly what the Atlas does. Belfast 2, anyone?

VIA BROOKLANDS MUSEUM

Connections, connections . . .

SIR — *TAH19* regaled readers with cracking tales of Skyway 748s, and a reminiscence (in a certain book review) of flying over the Pyramids in a Vimy. Fabulous to read, and here is a tale to link the two. Those titbits reminded me of this event.

There was a trip to the Paris Air Salon in 1969 organised by Weybridge RAeS Branch and it used the Skyways Lympne—Beauvais service out and back. On the return journey the coach was impeded by a severe accident on the road out of Paris. The driver arrived late at the airport, and the effort to re-establish our schedule was totally unexpected. Check-in formalities were minimised, and we were "ordered" to run to the aircraft (ex-BKS G-ASPL) which was on a self-manœuvring stand. The starboard propeller was spinning under the starter's influence as we streamed towards the rear door. It is important to note that the captain was visible to everyone as we raced across the apron, and it was the then very well-known first UK female captain, Yvonne Sintes.

As the last passenger boarded, the door was barely latched and the aircraft was moving off the stand, the port engine was running up to speed, and the race to the runway ended with a pirouette that had us lined up and roaring to take-off speed in a manner reminiscent of a "scramble" scene. It takes little imagination to foresee that within the cabin there was a terrific hue and cry of "(expletive deleted) women drivers!" Even so, this was soon drowned by the dismay that as the landing-gear was retracted the engine power was eased and the flaps did not retract — they extended!

A minute later Yvonne became fêted by 50 or so passengers as the most wonderful and lovable pilot in the world. The numerous members of the Weybridge-based team that had built their own Vickers Vimy replica, and had viewed it with pride at Le Bourget, were being reduced to gibbering human wrecks as their precious replica [seen airborne in 1969, **ABOVE**] — in the hands of Dizzy Addicott — came into view to port, and we overhauled it slowly.

I suspect our captain knew what reaction her passengers had accredited already. Yes, a 1960s touch of sexism, and also a clear example of what passenger-service meant in those days. Skyways did it beyond all expectations.

I'm enjoying *TAH* as much as ever.

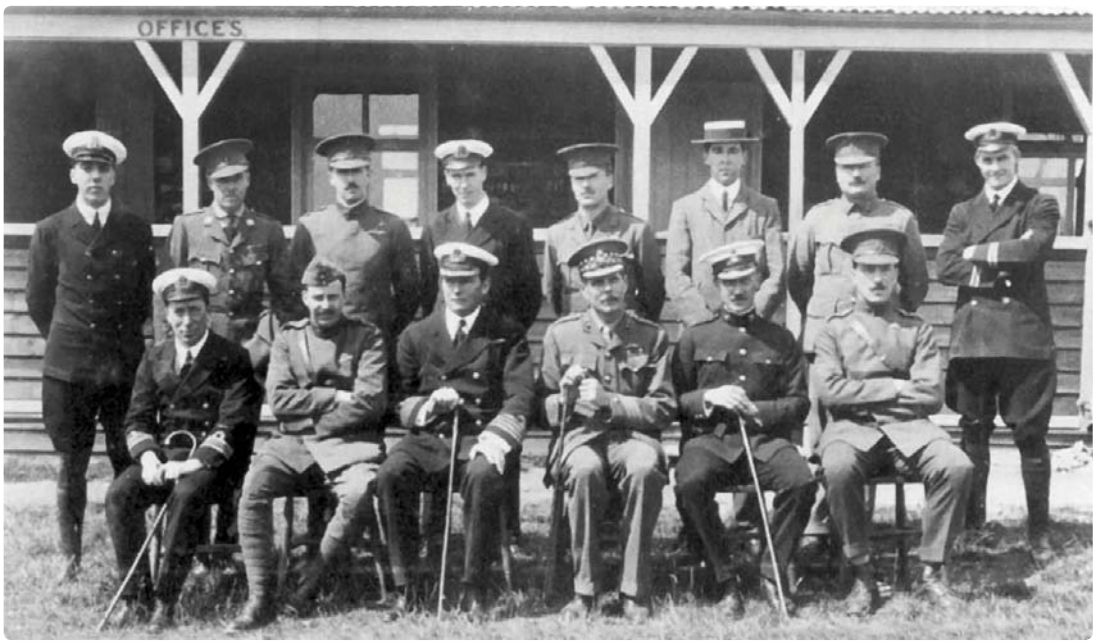
Mike Hirst *Loughborough, Leicestershire*

"Hitherto the creation of an Air Ministry and an [independent] Air Service has been looked upon as an idea to be kept in view but not realised during this war. Events have, however, moved so rapidly, our prospective aircraft production will soon be so great, and the possibilities of aerial warfare have grown so far beyond all expectations, that the change will brook no further delay and will have to be carried through as soon as all the necessary arrangements can be made . . ."

The Smuts Report, August 1917

NEW MODEL AIR FORCE

To commemorate the centenary of the establishment of the Royal Air Force in April 1918, **GREG BAUGHEN** takes an in-depth look at the reasoning behind the formation of the new independent air arm, and how invaluable wartime lessons learned about tactical air power were swept aside with the decision to focus on the RAF as a strategic bomber force



VIA AUTHOR

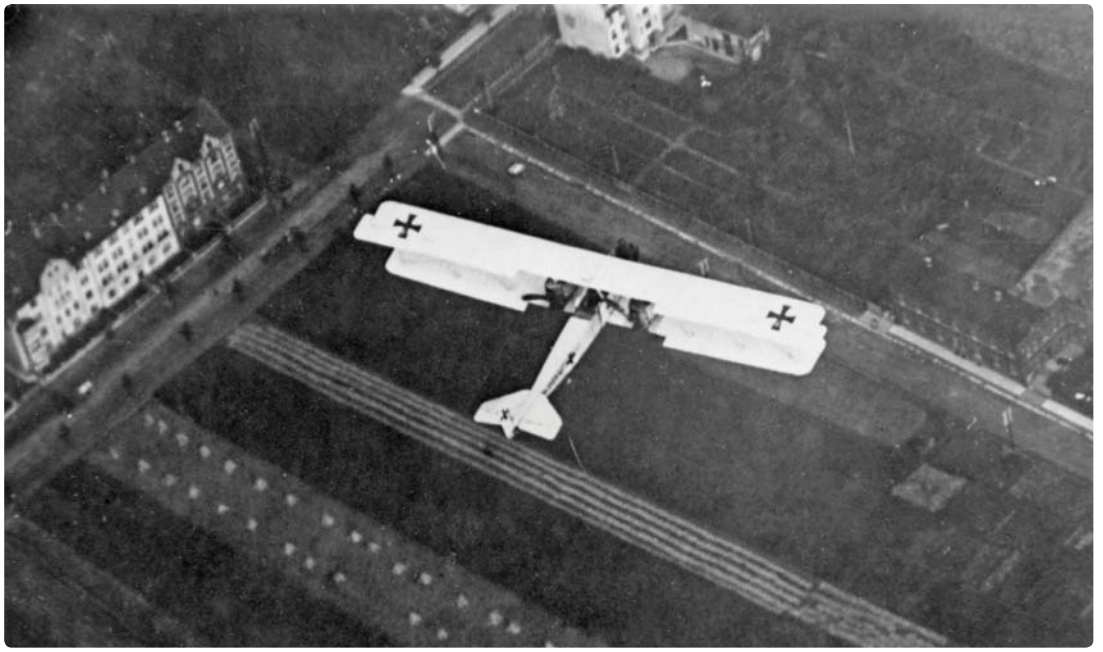
THIS YEAR THE Royal Air Force is 100 years old — and a century of distinguished service to the country is more than enough reason for celebration. It is a time to remember some of the Service's larger-than-life personalities, gruelling campaigns and spectacular individual achievements; and let us not forget those who flew with the Royal Flying Corps (RFC) in the years that preceded the formation of the RAF. There will be plenty of coverage of daring deeds in the weeks and months to come, and so there should be. However, every reorganisation has its advantages and its disadvantages — and the formation of an independent Royal Air Force was no exception.

The need for centralisation

Many of the reasons for combining the Royal Naval Air Service (RNAS) and RFC were sound enough. There was duplication between the Army and Navy development programmes and constant feuding between the two services over resources. Centralising control was a way of removing these problems — although perhaps it was merely a way of transferring these problems elsewhere. When the Air Ministry was finally formed in January 1918, instead of the Admiralty (Navy) and War Office (Army) arguing over air resources, the same clashes would continue in a three-way battle between the Admiralty, War Office and Air Ministry. With the benefit of hindsight, it was arguably the right time for a far more radical restructuring, with the establishment of a Ministry of Defence, perhaps even working towards a "Joint Force 1925", much as 100 years later the UK is edging towards a "Joint Force 2025". As it was, a fully fledged Ministry of Defence did not replace the old ministries until 1964.

The RFC had originally been created in 1912 as a unified air service with a Naval Wing and a Military Wing, but there were soon arguments about which Wing should control what. The Navy thought that airships clearly fell within its remit, but the Army argued that it may need them as well. The Army also saw no reason why it should not have a few seaplanes for operations near coastlines. In the middle of one particularly heated meeting, Capt Godfrey Paine (responsible for training Army and Navy pilots) found himself trying to remind everyone that it was supposed to be a *combined* service and it should not matter who had what.[1] It would be a long time before attitudes as sensible as that prevailed. The combined RFC soon fell asunder, the Military Wing keeping the Royal Flying Corps name, while the Naval Wing rebranded itself as the Royal Naval Air Service in 1914.

ABOVE ***A photograph of the staff of the Central Flying School at Upavon in January 1913, including a number of important characters who would play a major role in the formation of the Royal Air Force in 1918. Seated third from left is Capt Godfrey Paine RN; to his left is Maj Hugh Trenchard, who became the first Marshal of the RAF.***



PHILIP JARRETT COLLECTION

ABOVE ***In the summer of 1917 German Gotha bombers made their first forays over England, and the first daylight raid on London by G IVs (a development of the G II seen here) on June 13 resulted in the death of 18 children in a school in Poplar, opening what Air Cdre L.E.O. Charlton later described as "a new epoch in the history of warfare".***

During the early years of the First World War, the two branches of the air arm continued to trade blows, and it was often suggested that an independent air ministry and a unified independent air force might put an end to the bickering. However, issues over who had more right to what were not enough to bring about a major reorganisation, especially in the middle of a war. The Air Committee (established in April 1912), Joint War Air Committee (February 1916) and First and Second Air Boards (May 1916 and January 1917 respectively) attempted to impose some sort of order, but none was given the executive powers required to enforce decisions.

In the end it was Germany's Gotha bomber raids on London in 1917 that sparked change. The resulting heavy civilian casualties provoked calls for revenge and the Prime Minister, David Lloyd George, and his trusted advisor Gen Jan Smuts, were willing to believe those who claimed that bombing was the only way of bringing to an end a seemingly interminable war. The independent Royal Air Force was very much defined by the reason for its creation.

The strategic imperative

Problems would arise not so much because the RAF was independent; rather, it was the *reason* it became independent that caused the problems. The RAF was brought into existence to bomb Germany, and this inevitably became the Air Ministry's priority. If the Ministry and the RAF had been created to help resolve some of the operational problems the RNAS and RFC were facing, the RAF would have been an organisation with a very different outlook. It would not have been afraid of developing strategies that involved all the armed forces working together, and would still have had every opportunity to explore ways in which air power could be used independently. By not having all its eggs in the independent bombing basket, it may have been a little more analytical and critical about exactly how successful such a strategy might be.

By 1918 the RFC had made enormous progress and had evolved into a modern, flexible tactical air force. Many of the criticisms later flung in the RFC's direction were scarcely justified. The Air Ministry would make much of the Army practice of attaching air units to particular ground units. In fact, during the March 1918 German offensive, fighter and bomber units attached to armies on fronts unaffected by the offensive, and even artillery observation squadrons attached to army corps, were switched to where the German Army had broken through, and were used in the ground-attack role. Most RFC squadrons were attached to armies and corps, but it only took a simple order to unattach them. The role played by the RFC in defeating the March 1918 offensive turned into a brilliant demonstration of how the flexibility of air power could be used to help halt a dangerous enemy advance. It proved to be the RFC's last hurrah. On April 1, 1918, the RFC became the Royal Air Force.

In the final year of the war, the RFC and RAF used techniques that most would associate with

PHILIP JARRETT COLLECTION

ABOVE ***An R.E.8 of No 59 Sqn RFC goes about its work of artillery spotting, reconnaissance and general Army co-operation duties. The unit, formed in August 1916, moved with its R.E.8s to France in February 1917 and began developing invaluable tactical air power methods that would have to be developed all over again in the next war.***

the much later 2nd Tactical Air Force. In the First World War, wireless equipment was too heavy for forward troops to carry into battle, but the aircraft flying above them could. It was not long before elaborate systems had been established to bring artillery fire to bear on any fleeting targets the observation aircraft might spot. When fighters started carrying bombs, it was a relatively simple matter to use the same systems to call in air support to hit these targets. When an observation aircraft spotted a target, commanders had a choice of employing artillery or using fighter-bombers to deal with it. In 1918 Royal Aircraft Factory R.E.8 squadrons were already doing what Austers in the AOP (air observation post) role would do in the closing stages of the Second World War, and what USAF forward air controllers (FACs) did to exceptional effect in the Vietnam conflict five decades later.

Army commanders were fully aware of the different options air power offered. They realised there were targets in the battle zone that aircraft could attack more effectively. Troops marching along a road were a difficult target for artillery but easy prey for strafing fighters. The Germans were quick to adapt anti-aircraft guns into anti-tank weapons, which tank crews found difficult to spot. Observation aircraft could see them, but the guns were usually too close to the tanks to bring in artillery fire without endangering the tanks. Ground-attack aircraft could provide pinpoint attacks without endangering friendly forces. It became standard practice for RAF aircraft to fly ahead of the tanks to see what was around the next corner, just as USAAF Republic P-47 Thunderbolts were used in France in 1944.[2]

"Creeping barrages" were a crude and often dangerous way of supporting advancing infantry. Strafing aircraft flying low over troops going "over the top" ensured the enemy ahead kept their heads down and greatly boosted the morale of the advancing infantry. At the end of the First World War, wireless equipment still had to be carried by aircraft, but the Army was already anticipating the day when the kit would be light enough for frontline troops to carry it into battle. Brigadier-General L.E.O. Charlton, commander of the RAF's V Brigade supporting the British Fourth Army in France, envisaged a future when a lowly platoon commander would be able to call in air support if his troops were being held up by an enemy strongpoint.[3]

Different approaches

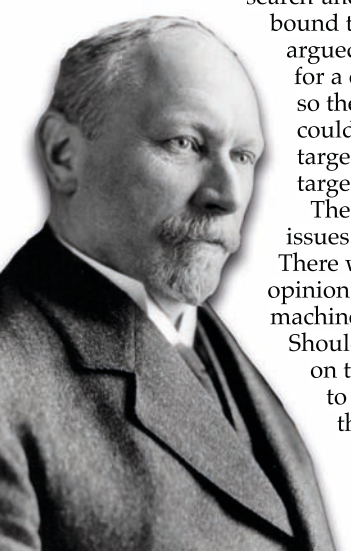
In 1918 all these developments were still in their infancy and there remained much debate about how to take the ideas forward. There were issues about how to apply close air support. Different Army commanders adopted different approaches. Some had their Sopwith Camel fighter-bomber squadrons at readiness, bombed up and all set to intervene as soon as an appropriate target emerged. However, this was not always so straightforward. The air support the RAF's V Brigade provided for the British Fourth Army on September 29, 1918, during the latter's assault on the Hindenburg Line, was a case in point. Three squadrons and a flight were

PHILIP JARRETT COLLECTION

ABOVE ***Following experiences in the Battle of Cambrai in late 1917, in which low-flying aircraft were used extensively for "strafing runs" (leading to a correspondingly high attrition rate), Sopwith developed the sole Camel Trench Fighter (T.F.1), armed with a pair of downward-firing Lewis guns and fitted with armour plating.***

on standby throughout the day, but the first day of this particular offensive was one of much confused fighting and the corps' machines were not able to establish a clear picture of events. As a result, there were no obvious targets for the fighter-bombers to attack. No request for air support was made until midday, and by 1600hr only four sorties had been flown.[4]

On the same day, far more sorties were flown on the Second Army Front, where fighter squadrons were given maximum licence to seek out and strike targets of opportunity. The targets, however, were inevitably more random and less relevant — but, arguably, it was better than aircraft sitting on their airfields doing nothing. The counter-argument was that scouring the battle zone for targets involved spending too long in dangerous skies and losses on such search-and-destroy sorties were bound to be higher. Some argued it was better to wait for a clear target to emerge so the fighter-bombers could fly straight to the target and return. If no targets emerged, so be it.[5]



There were also technical issues that needed resolving. There were differences of opinion about the types of machine that should be used. Should fighter-bombers rely on their manœuvrability to evade groundfire, like the Sopwith Camel, or be heavily armoured like the same company's Salamander; or something in between like the Camel Trench Fighter (T.F.1)? Tanks were beginning to carry radio equipment, but there were problems establishing contact with the spotter aircraft above.[6]

The Smuts report

Even within the narrow field of close air support there was plenty for an independent Air Ministry and RAF to ponder, analyse and discuss. Building on the progress made in the First World War would have been a worthy task for the new Ministry, and would have ensured that the RAF had the aircraft and tactics that would be sorely needed in 1940, when a new German Army was threatening to overrun Western Europe. However, the Air Ministry was not created to do this. It was the Gotha bombings of London and the need to retaliate that had prompted the creation of an Air Ministry and independent RAF. The official *Report by General Smuts on Air Organisation and the Direction of Aerial Operations*, written by Jan Smuts (**LEFT**) and issued in August 1917, made it clear that the country should prepare for a new type of war:

"The day may not be far off when aerial operations, with their devastation of enemy lands and destruction of industrial and populous centres on a vast scale, may become the principal operations of war, to which the older forms of military and naval operations may become secondary and subordinate."[7]

This was what the Air Ministry and RAF were expected to work towards. The Air Ministry was

not created to develop naval and military air support; it existed to turn Smuts's vision into a reality.[8] The RFC in France became part of the RAF, but its commander, Maj-Gen John Salmond, still reported to the War Office. Even the sophisticated air-defence system set up to defend London remained largely a War Office project, with the RAF contributing fighter squadrons, but with the Army responsible for developing and organising the system.

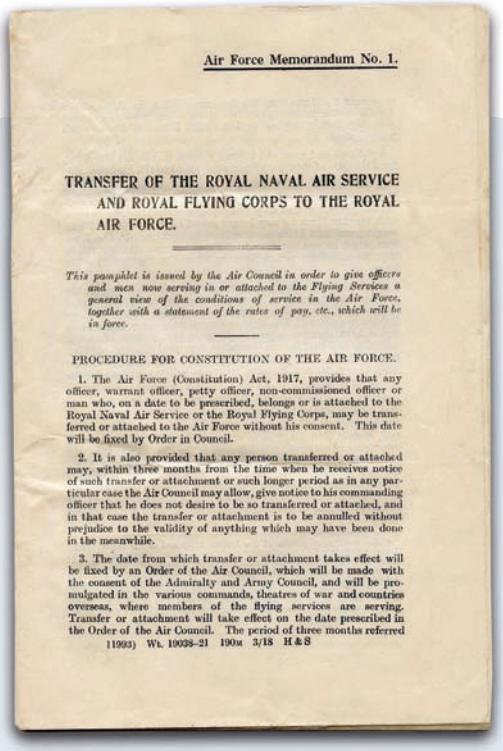
Smuts expected the new Air Ministry to give "the closest attention . . . to the special requirement[s] of the Navy and the Army", but it soon became clear this was going to be difficult.[9] Large long-range bombers like Handley Page's twin-engined O/400 and the mighty four-engined V/1500 used up valuable resources and were very expensive to build. The Air Ministry soon realised that the bomber force it wanted could be created only by slashing the planned expansion of the RAF's naval squadrons and Salmond's tactical air force in France.[10]

Battle lines were drawn, with the Admiralty and the War Office on one side and the Air Ministry on the other. In the final months of the war there were heated discussions between the opposing factions, as fierce as anything that had preceded the formation of the RAF.[11] The War Office won back much of the ground lost and the Air Ministry had to settle for a far smaller bomber force than it wanted. The final deal left both sides dissatisfied. Strategic bomber fleets do not grow on trees and the simple truth was that Britain could not afford to build a large long-range bomber force and still provide the Army and Navy with the air support they needed.

Betting on the bomber

This basic fact dominated defence planning throughout the inter-war years. The RAF, on paper, had a three-fold role of supporting both the Army and Navy and developing a long-range bomber fleet — but it was the latter that had priority. Indeed, with tighter peacetime budgets, a powerful tactical air force became an obstacle to the development of a long-range bomber fleet. Public and political opinion was on the side of the bomber advocates. Nobody wanted to fight another Great War, with its squalid trench warfare, and everybody feared the destruction the bomber could wreak in the next war. Politicians were very aware of this.

The bomber thus became a diplomatic weapon of enormous importance, as the 1938 Munich debacle — underpinned by fear of war if Hitler's territorial ambitions were not tolerated — infamously illustrated. The British government needed a powerful bomber fleet to bolster its position at the negotiating table, and this was



Air Force Memorandum No. 1.

TRANSFER OF THE ROYAL NAVAL AIR SERVICE AND ROYAL FLYING CORPS TO THE ROYAL AIR FORCE.

This pamphlet is issued by the Air Council in order to give officers and men now serving in or attached to the Flying Services a general view of the conditions of service in the Air Force, together with a statement of the rates of pay, etc., which will be in force.

PROCEDURE FOR CONSTITUTION OF THE AIR FORCE.

1. The Air Force (Constitution) Act, 1917, provides that any officer, warrant officer, petty officer, non-commissioned officer or man who, on a date to be prescribed, belongs or is attached to the Royal Naval Air Service or the Royal Flying Corps, may be transferred or attached to the Air Force without his consent. This date will be fixed by Order in Council.

2. It is also provided that any person transferred or attached may, within three months from the time when he receives notice of such transfer or attachment or such longer period as in any particular case the Air Council may allow, give notice to his commanding officer that he does not desire to be so transferred or attached, and in that case the transfer or attachment is to be annulled without prejudice to the validity of anything which may have been done in the meanwhile.

3. The date from which transfer or attachment takes effect will be fixed by an Order of the Air Council, which will be made with the consent of the Admiralty and Army Council, and will be promulgated in the various commands, theatres of war and countries overseas, where members of the flying services are serving. Transfer or attachment will take effect on the date prescribed in the Order of the Air Council. The period of three months referred

11993) Wt. 19038-21 190m 3/18 H&S

PHILIP JARRETT COLLECTION

"TALLY-HO — ARDIAN . . ?"

WITH THE CREATION of a new independent air force came the prickly issue of establishing a new rank system. This was not as straightforward as it would seem, as every member of the new air arm already either had a Naval (RNAS) or Army (RFC) rank. A list of suggested titles was drawn up, mostly taken from the Navy or Army. Neither was very happy with the suggestions, the Navy being reluctant to share its illustrious titles with the "junior service", and the Army complaining that the majority of the more senior titles were naval ranks.

A new list of officer ranks was thus drawn up, comprising Ensign, Lieutenant, Flight Leader, Squadron Leader, Reeve, Banneret, Fourth Ardian, Third Ardian, Second Ardian, Ardian and Air Marshal. An alternative list varied the ranks above Sqn Ldr to read Wing Leader, Leader, Flight Ardian, Squadron Ardian, Wing Ardian, Ardian and Air Marshal. "Reeve" was an Anglo-Saxon term for a local official, a "Banneret" was a knight who commanded his own troops in battle under his own banner and "Ardian" was based on the Gaelic words "Ard" (chief) and "Ian" or "Eun" (bird).

By the time Air Force Memorandum No 1 (**ABOVE**) was issued in March 1918, dealing with the rather prosaic (but essential) matters of pay grades and ranks, it had been decided to adopt a predominantly Army-based rank system, the Memo listing the main new officer ranks as Lieutenant, Captain, Major and Lieutenant-Colonel. The familiar ranks known to us now — Pilot Officer, Flying Officer, Flight Lieutenant, Squadron Leader, Wing Commander, Group Captain, Air Commodore, Air Vice-Marshal, Air Marshal, Air Chief Marshal and Marshal of the RAF — would not be introduced until August 1919. **NS**

TAH ARCHIVE

ABOVE ***Members of No 207 Sqn RAF pose beside one of the unit's Handley Page O/400 bombers, about to be fitted with a gift for the Kaiser, an 1,800lb SN bomb with a personal inscription, at Ligescourt, near Abbeville, in August 1918. Development of a strategic bomber force was to become the central focus of the post-war RAF.***

precisely what the Air Ministry had been set up to provide.

There was never any serious analysis of what the bomber might realistically be capable of in wartime, as opposed to what it might threaten to do in peacetime. Instead, the Air Ministry, under Chief of the Air Staff Hugh Trenchard's guidance, accepted the wild predictions that were circulating at the time and used them to justify not just an independent RAF but, more significantly, the establishment of a strategic bomber force that would play the decisive role in any future conflict. Instead of developing the tactical role the RAF had so successfully performed at the end of the First World War, the RAF was given a role in the next major conflict that it could never possibly hope to achieve. The more the Air Ministry advocated a bomber-led war, the greater the gulf between Air Force, Army and Navy became. The Royal Navy had its Fleet Air Arm but there was no equivalent for the Army. Instead of a fully fledged air arm, the Army had to make do with so-called "Army co-operation aircraft".

With any new organisation, there is always a desire to start afresh. One of the major disadvantages of a "new broom sweeping clean" is that previously gained expertise can be lost. After much trial and error, the way the RFC and RAF were used tactically in the First World War became a genuine blueprint for how to use air power in future wars. In 1918 fast, reliable tanks had not yet been developed, but Britain had already developed the air element of the future "Blitzkrieg" style of warfare. Instead of building on the progress made, the bomber strategy the Air Ministry devised for the newly-minted RAF resulted in the invaluable lessons of the First World War being discarded. It would be a long hard road, with many defeats and setbacks along the way, before the RAF would again support the British Army as effectively as it had in 1918.

ENDNOTE REFERENCES

1 The National Archives (TNA) ref CAB 14/17, Nov 1912
2 TNA refs AIR 1/725/97/10, AIR 1/1074
3 TNA refs AIR 1//677/21/13/1887, p81
4 TNA refs AIR 1//677/21/13/188, Sep 29, 1918
5 TNA refs AIR 1//677/21/13/1887, Sep 1918
6 TNA refs AIR1//725/97/10, July 1918
7 Jones, H.A., *The War in the Air*, Appendices, Appendix II
8 Ibid
9 Ibid
10 TNA refs AIR 1//17/15/1/85, June–Sep 1918
11 Ibid

GREG BAUGHEN is the author of *Blueprint for Victory* and *The Rise of the Bomber* (both Fonthill Media), the first two volumes in a series detailing the history of British air power, from its early days to the height of the Cold War. For more info visit **www.facebook.com/gregbaughen**

THE SECOND YP-38 IN THE WINDTUNNEL AT LANGLEY / NASA

LOCKHEED CONSTERNATION

Compressibility & the P-38 Lightning

In the concluding article in his three-part series on aerodynamic developments during a critical period of experimentation, **MATT BEARMAN** argues that the problems caused by the unique shape of the Lockheed P-38 had already been solved by the time its co-designer, Clarence "Kelly" Johnson, was forced to look at the problem of compressibility

THE HISTORY OF Lockheed's distinctive P-38 Lightning is well known. According to the legend, it was a stunning design that flowed in part from the genius of the best aircraft designer in the world. It was the "fork-tailed devil" that took on the Luftwaffe in ways nothing else could, but which had a flaw: its wing caused compressibility problems. At Mach 0·68 the P-38 began shaking violently, and soon after would pitch down into a dive that only gentle application of the trim tabs could resolve.

The myth continues; nobody could have predicted this — the Lightning went faster than everything else, so it was the first to encounter the speed of sound over its aerofoils (notwithstanding Messerschmitt test pilot Kurt Jodlbauer's July 1937 death in a Bf 109 during a high-speed dive test, in which the aircraft experienced compressibility and plunged into Lake Muritz). Eventually some clever people at Lockheed, led by chief designer Clarence "Kelly" Johnson, who could "see air", worked out the complex mathematics for the first time and came up with a solution to the uncontrollable dives the aircraft would pitch into at speed and all was well again. That story may sound familiar, but every part of the last sentence is almost certainly nonsense.

Johnson, a research engineer under the leader-

LEFT ***Clarence "Kelly" Johnson joined Lockheed in 1933 and established his reputation with work on the Lockheed 10 and other predominantly civil types, before being appointed chief research engineer in 1938. The P-38 was the result of a February 1937 USAAC Specification, with Johnson playing a major part in its design under the supervision of the company's chief designer, Hall Hibbard.***

ship of chief designer Hall Hibbard at the time of the P-38's inception, later remarked: "I broke an ulcer over compressibility on the P-38. We flew into a speed range where nobody had been before, and we had difficulty convincing people that it wasn't the funny-looking aircraft itself, but a fundamental physical problem . . . we worked through the whole war to get 15kt more speed out of the P-38 — we darn near doubled the power. We saw compressibility as a brick wall for a long time. Then we learned how to get through it, and we went Mach 2 with the F-104 and beyond Mach 3 with the [SR-71] Blackbirds".[1]

Although Johnson established a reputation for straight-talking, he never really managed it when it came to the P-38. An effective change that would move "the wall" back 50 m.p.h. (80km/h) had been proposed and demonstrated at least twice before the dive flaps ultimately fitted to the P-38 as a solution were tested. It now also appears likely that Johnson's own research engineering team had produced a better solution as early as September 1941 — and then for its own reasons failed to adopt it.

FASHION VICTIM

The P-38 was arguably something of a fashion victim. In the decade before Johnson put pencil to paper everything was designed with copious use of the "streamline", or elongated egg shape. The trouble is that this shape is an aerofoil, and aerofoils accelerate the air passing over them relative to themselves. The parcel of air moving over the "shoulder" of the P-38 is accelerated by two aerofoils at once; one created by the flanks of the egg-shaped cockpit nacelle, and one created by the wing. In terms of pressure gradients and velocities, the air behaves as if it was being acted on by one combined "virtual aerofoil" of much greater thickness than the wing alone. A consequence of this is early flow separation (also known as burble), which, when it hits the tail, is called buffeting. Another is greatly increased wave drag (see glossary on page 21) and reduced critical Mach (ditto).

That the P-38 had no rear fuselage, but held a narrow-chord tailplane by means of two booms trailing behind the engines instead, is not particularly unusual. Several other aircraft made use of this expedient, including its near-contemporaries the Northrop P-61 Black Widow and the Focke-Wulf Fw 189. The Dutch had already mass-produced the elegant Fokker G.I. All had a design feature that the P-38 did not — the continuation of the fuselage pod aft of the wing junction. Adopting this staggered configuration meant a reduced pressure gradient and a lower induced velocity over the wing root for the G.I — a good thing. However, even without going into the mathematics (which Johnson was fully capable of doing), the empirical evidence alone showed that aligning the P-38's wing junction trailing edge with the aftmost point of the fuselage pod would create a problem.

In his report on model tests in the National Advisory Committee for Aeronautics (NACA) variable-density windtunnel as early as 1937, aerodynamic pioneer Eastman "Jake" Jacobs stated that "the interference burble does not appear when the wing is in the most forward mid-wing position, but is present for the second position back and occurs progressively earlier as the wing is moved backwards from this latter position".[2] This much was known, and most designers kept wings well forward on bodies.

At a lecture given at the Fifth Volta Conference in Rome in 1935, the same Dr Jacobs presented the earliest scientific observations of supersonic shock behaviour in the USA. As early as this, Jacobs was able to show that "the critical Mach number could be increased by shape changes which could be determined through observation of burble in low-speed tests".[3] The onset of burble and supersonic shock were related.

This latter connection did not seem to be worthy of discussion among the more "fashionable" aerodynamicists of Johnson's generation. Until at least 1944, higher-speed burble around wing roots behind the maximum thickness, while a known problem, was largely misidentified in the

PHILIP JARRETT COLLECTION

The Dutch Fokker G.I made its first flight in March 1937 and showed a great deal of promise as an adaptable heavy fighter/ground-attack aircraft. It shared the twin-boom configuration with the P-38 but, significantly, had a fuselage pod that extended beyond the wing trailing edge. During trials it was specifically noted that the G.I could be dived at high speed — in marked contrast to its American contemporary.

USA as connected with wing/fuselage angles in the vertical plane and "'mutual interference" — again not really seeing what the three-dimensional shape was doing to velocities and dynamic pressures near critical Mach.

The P-38 did generate a severe burble, which showed up as buffet on the tail, and which was reduced with the fitting of Lockheed-designed wing-root fillets at the leading edge from the P-38D model onwards. We will pause here to try and make some sense of the terms burble, buffet and flutter. Several authors of comprehensive studies of the P-38 have called the problem that these fillets addressed "flutter". This is an aero-elastic phenomenon in which some extremity oscillates around a natural hinge-point because a harmonic to a fundamental frequency has been established by the dynamic interaction of a flexing airframe with aerodynamic forces. Johnson was adamant that the P-38's rigid twin-boom structure did not suffer from flutter. That he was right about this was demonstrated when local strengthening of the stressed skin to alter the dynamic properties and harmonics of the structure made no difference at all to the vibration.

The US Army Air Corps (USAAC), on the other hand, was convinced that flutter was the problem. Lieutenant-Colonel Kenneth B. Wolfe, head of US Army Production Engineering, insisted that every P-38 carry lead weights on armatures attached to the elevator to damp the (non-existent) oscillations. As Johnson noted, these made no difference.[4] Other writers, notably the late Warren M. Bodie, have stated correctly that the problem was aerodynamic buffet — separated flow hitting the tail — but have been at pains to point out that this problem was not linked to compressibility, while "locking up" and pitching down in a dive was.[5] Bodie goes on to say that in the case of the P-38, buffet was caused, as Lockheed implied, by the air at peak velocity (see glossary opposite) and inverse peak pressure (ditto) around the wing root approaching M1·0 and causing flow separation — very much a compressibility issue. Unsurprisingly this has led to much confusion. In 1978 the late Jeff Ethell stated that buffet and compressibility were two different phenomena, one closely following the other,[6] and then put buffet and compressibility together in 1983.[7]

What is clear is that Lockheed, working on the principle that local acceleration at the leading edge was causing separation, came up with a fillet that reduced this effect and cured the shake at around M0·65. Johnson had this pinned as a compressibility effect all along. But there was a second vibration that came on at higher speeds, roughly around M0·68. This originated from the trailing edge of the wing and was the one that turned into "Mach tuck" (in which the nose of an aircraft pitches downward as the airflow around the wing goes supersonic) at around M0·71, leading to fatalities. This could not be cured with a simple fillet.

MEANWHILE, BACK IN BRITAIN . . .

In the UK de Havilland had already extended the rear of the Mosquito's engine nacelles to project behind the wing so as to cure a vibration problem. Westland designer W.E.W. "Teddy" Petter had done the same with his Whirlwind twin-engined fighter. As aircraft regularly began to reach 400 m.p.h. (645km/h) in normal operation, this design concession to compressibility proved a necessity. It also had the benefit of reducing subsonic separation and drag.

In February 1942 H.B. Howard of the British Air Commission in Washington DC wrote to Col Ben Kelsey of the USAAC.[8] Kelsey had co-written the P-38 specification back in 1936, performed the maiden flight of the XP-38 on January 27, 1939, and remained the most senior officer on the type throughout the war. Howard's letter ran thus:

"Mr Petter of the Westland Aircraft Co in

"Johnson could not have been ignorant of the fact that being unable to take his sleek and supposedly low-drag airframe beyond M0·6 in level flight, no matter how much power was poured on, meant there was something wrong elsewhere . . . the P-38 was fundamentally the wrong shape, although it seems that Lockheed could not admit it"

England, who designed the Whirlwind, has been studying the P-38 problem. He says that they have invariably had trouble when they have required that the air should expand simultaneously in two planes, as for instance when a body is mounted on a wing and its streamline tail coincides with the trailing edge of a wing, or when a fin and tailplane intersect and their trailing edges are roughly in the same plane. I send you these ideas in the hope they may be of use to you."

According to a handwritten footnote, Kelsey forwarded this on to Lockheed, although the USAAC remained adamant that the problem was only aeroelastic flutter. History does not record whether it was read.

Although the P-38 was certainly fast, this was not an unknown speed range by any means. Other aircraft were diving faster. The P-38's NACA 23016 aerofoil, although thick, was good to M0·75 on its own. Johnson could not have been ignorant of the fact that being unable to take his sleek and supposedly low-drag airframe beyond M0·6 in level flight (Wright Field test figures), no matter how much power was poured on, meant there was something wrong elsewhere; although critical Mach was a fundamental problem, this was not where the "wall" should be. The P-38 was fundamentally the wrong shape, although it seems that Lockheed could not admit it.

Much has been made of the P-38's low total drag, largely based on its looks. In 1943 NACA recorded the Cd_0 (zero-lift drag coefficient) of the YP-38 in flight as 0·029,[9] while the Royal Aircraft Establishment (RAE) in the UK measured a production P-38 at 0·036,[10] rising sharply above M0·6 to 0·050 at M0·67. By comparison, in the British tests the Republic P-47 revealed a Cd_0 of 0·015–0·020 in the same Mach range and the Spitfire Mk XIX a Cd_0 of 0·016–0·018. The P-38 was not a low-drag aeroplane. Even based on the NACA figures, with a Cd_0 similar to that of a Douglas DC-3, it was something of a brick; a 2,300 h.p. brick — but compressibility is a drag multiplier. The highest speed attainable by the P-38 — according to official figures — was M0·68. The USAAC implied in a pilot's training diagram that this was the remarkably high maximum level-speed of the aircraft. It wasn't — it was a remarkably low safe-speed when diving.

TECHNICAL GLOSSARY

Critical Mach The lowest Mach number at which the airflow over some point of the aircraft reaches the speed of sound — by definition this point will be in the region of **peak velocity** and **inverse peak pressure** (see below). The higher the peak the lower the critical Mach

Downwash The deflection of air downwards behind the trailing edge of the wing — equal and opposite to the lift generated by the wing, according to Newton's Third Law, i.e. for every action, there is an equal and opposite reaction

Lift coefficient (C_L) A "dimensionless" number derived from an equation used to express how much lift a body generates

Peak velocity / inverse peak pressure The highest relative speed reached as air is accelerated by passing around an aerofoil is sometimes referred to as "peak velocity". At peak velocity the air will also be at its lowest static pressure, referred to in this article as "inverse peak pressure"

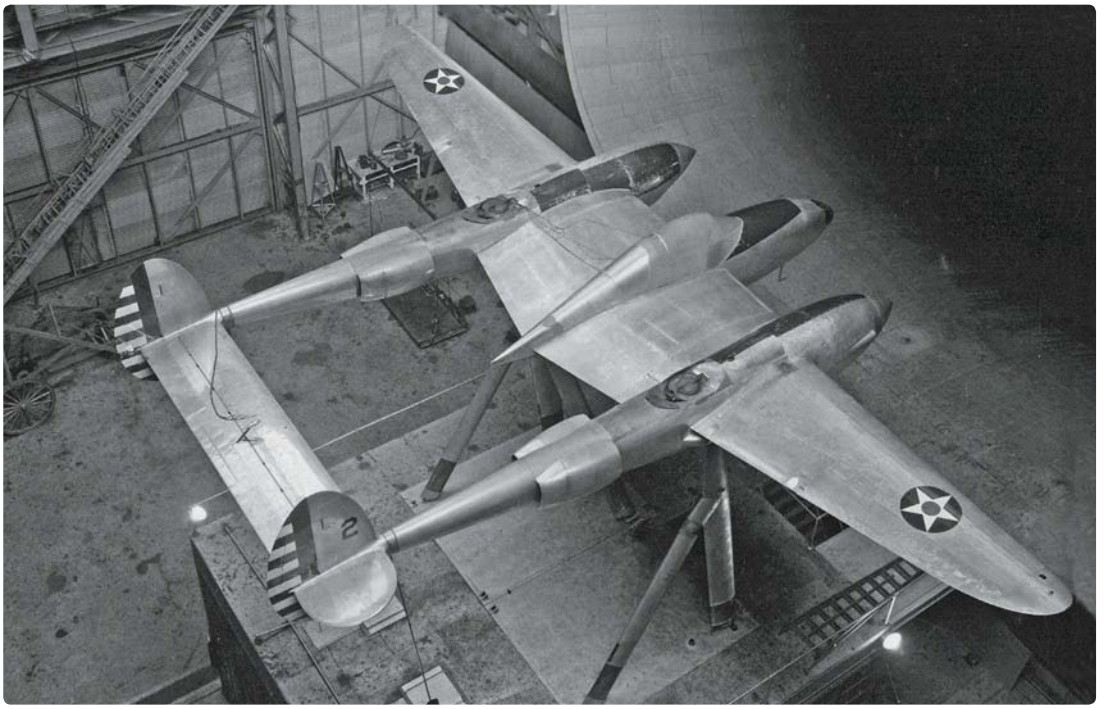
Shock(wave) One of the effects of locally accelerating air to a velocity (relative to a surface) above Mach 1, and also of decelerating it again, the shockwave is in fact a narrow zone spreading out from the surface. In this zone the properties of air as a fluid change dramatically as it is locally compressed and decompressed

Variable density windtunnel A tunnel designed to compress air to high densities to simulate full-scale conditions using scale models

Wave Drag As an aircraft accelerates through critical Mach it experiences a dramatic increase in drag. The largest (but not the only) component of this is "wave drag" resulting from the presence of shockwaves, which dissipate energy

MIDNIGHT OIL AND FURROWED BROWS

In Burbank, California, consternation among the Lockheed staff was growing. The USA was now entering the war with a fighter that shook violently as speed increased, and then suddenly pitched over into a control-locking dive that could, and did, prove fatal. Doubtless there were business concerns over future contracts and share price; there is no way this could not by now have been recognised for what it was — a basic design flaw. Tales of midnight oil and furrowed brows, apparently trying to work out why the Lightning behaved as it did, do not tell the whole story.



NASA

ABOVE ***The second YP-38, serial 39-690, mounted in NACA's full-scale windtunnel at Langley in December 1941, fitted with an extended fuselage pod and a re-profiled inner wing section of deeper chord. It was these modifications that Guryansky and Preston claimed raised the aircraft's critical Mach by some 44 m.p.h. (70km/h).***

The windtunnel engineers at NACA had solved the problem long before the application of the P-38's famous dive flaps. The first NACA experiments were sponsored by the USAAC at the request of Lockheed, once the latter had done all it could "in-house" (although some P-38 histories claim that NACA's role was to interfere bureaucratically and slow down the development of a solution). Lockheed wanted to place a model into NACA's 8ft (2·4m) high-speed windtunnel, the domain of distinguished aerodynamicist John Stack. Unfortunately, this was booked out for development work on Boeing's new B-29 bomber. A furious Johnson later claimed that NACA was worried about operating the windtunnel at high speeds, and an unfounded internet-reinforced myth has grown up about a NACA refusal to run tests on a model in the 8ft tunnel, leading to delays. There is no evidence of this, however, and NACA had routinely been running the tunnel at high Mach with all kinds of shapes in it for years.

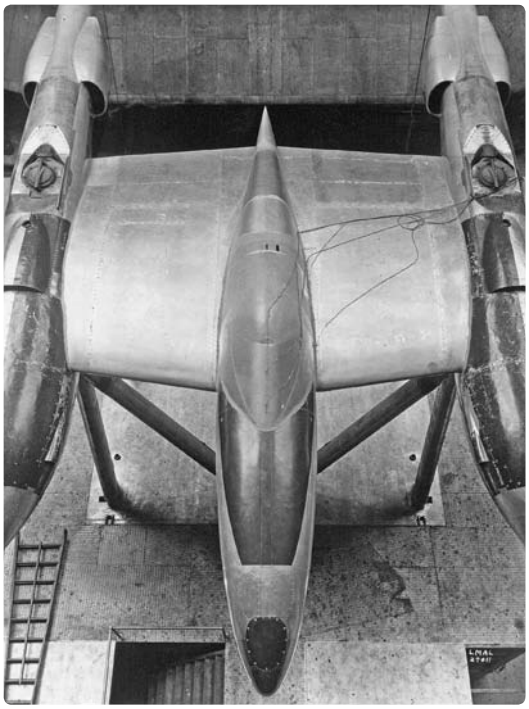
Indeed, according to author George Gray in his 1948 book on NACA research, the organisation's team put aside several high-speed research programmes in order to work "nights and Sundays" to deal with the urgent P-38 problem.[11] While waiting for the tunnel to become available, the USAAC put the second YP-38 into the full-scale research windtunnel at Langley from late November 1941 to February 1942. The following month's report by Eugene R. Guryansky and G. Merritt Preston put it all down to compressibility, just as Johnson had (which would have annoyed the Air Corps), and provided solutions.[12]

The results were imperfect in that the "runs" were only undertaken at 100 m.p.h. (160km/h) free-stream speeds, and the effects of compressibility were only predicted from observed pressures and a lot of brand-new theory. The problem was identified as too high a combined velocity over the wing and fuselage, owing to the shape of both.

The solutions were straightforward — a wing profile with reduced peak velocity for the inboard section and a canopy the same, faired into a fuselage with a grafted-on tail-end elongation, giving a straighter junction. Unfortunately, according to NACA's own account, none of these was acceptable to Lockheed or the Air Corps.[13]

It is perhaps understandable that the USAAC might not be inclined to concur with contrary conclusions extrapolated from extremely complicated mathematics when it was wedded to the idea of this being a case of flutter. Lockheed's attitude, when Johnson says that he knew it was compressibility all along, is harder to fathom. The company had given the aircraft up to the aerodynamicists and said "fix it". They did, at the same time — in theory at least — delaying the onset of shock by some 44 m.p.h. (70km/h). Then Lockheed rejected the fix. Furthermore, a very unhappy Johnson called Merritt Preston a "bastard" for "tearing up my P-38".[14]

The perception has arisen among some P-38



NASA

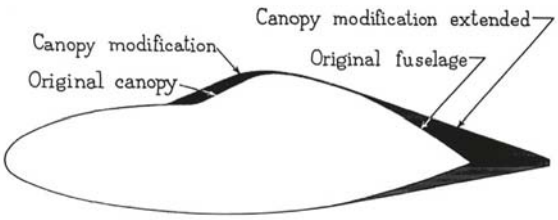
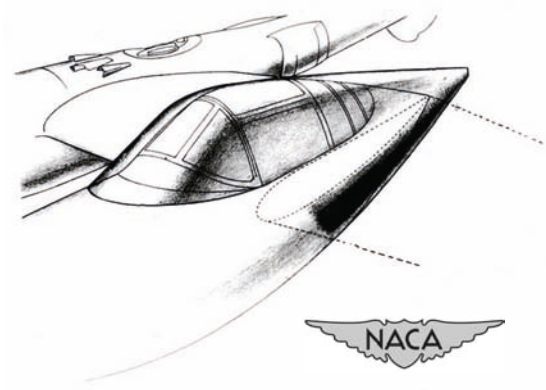


Figure 38.- Canopy modification on airplane 4.



ABOVE LEFT ***Another view of the re-profiled wing and fuselage pod extension fitted to the second YP-38 at Langley in December 1941.*** **ABOVE RIGHT** ***Illustrations of the proposal arising from NACA research engineer Albert Erickson's October 1942 paper, in which he suggested modifying and extending the P-38's fuselage pod.***

historians that the tested alterations didn't work. They most definitely did. This idea, completely opposite to the crystal-clear results printed in the report, may be based on a misunderstanding of the test's purpose, which these historians regard as being to smooth out the airflow — or simply because the recommendations were not taken up.

A SECOND OPINION

Meanwhile, the 8ft windtunnel became free and Stack's team got to work. Unfortunately, the report of this part of the project, recorded as *Wind-Tunnel Tests of ⅛th-scale P-38 Model in the 8ft High Speed Tunnel*, was never released publicly. This "missing" report was in fact written by Stack's colleague Eugene Draley, an early pioneer of the importance of wing/body junction shapes and author of the previous year's NACA report *High Speed Drag Tests of Several Fuselage Shapes in Combination with a Wing*. We may never know what Draley actually said in his report, as the file containing the unpublished draft remains "not open to researchers".[15]

What we do have is the follow-up from NACA's Ames Aeronautical Laboratory in California, which took over the research project from Stack's 8ft windtunnel team so as to be nearer to Lockheed. Drawings accompanying the NACA memo by Albert L. Erickson, published in October 1942, show an elongated fuselage that reduces the two-way forced expansion and the pressure gradient.[16] The summary reads:

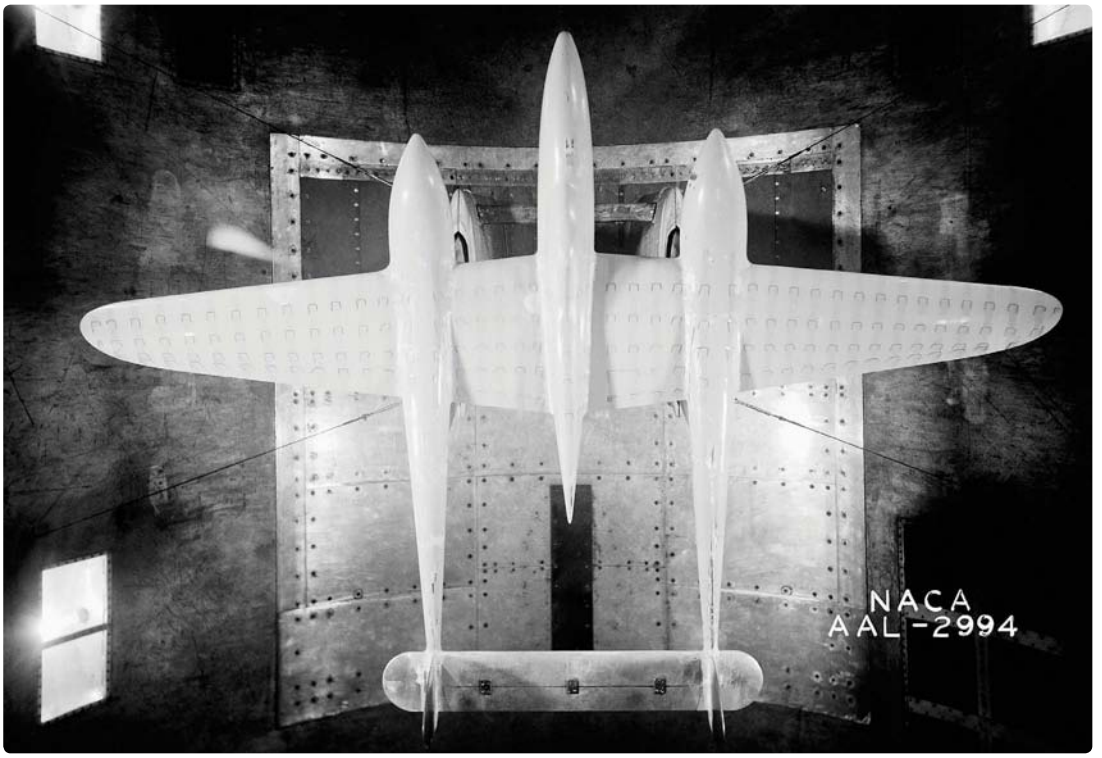
"A pursuit-type [aircraft] encountered severe diving moments in high-speed dives which make recovery difficult. For the purpose of investigating these diving moments and finding a means for their reduction, a ⅛th-scale model of the airplane was tested in the 16ft high-speed windtunnel at Ames. The test results indicate that up to a Mach number of at least 0·75, the limit of the tests, the dive-recovery difficulties can be alleviated and the longitudinal manœuvrability improved by the substitution of a long symmetrical fuselage for a standard fuselage".

It is hard to read this as anything other than a second clear statement of where the problem lay and what needed to be done about it. The detailed conclusions are worth reading in full:

"1) The difficulty encountered by this pursuit airplane in recovering from high-speed dives is caused by a compressibility shock on the wing centre section. This shock causes a loss in lift and a reduction in the downwash [see glossary], *which results in a large change in the tail moments;*

2) With the standard fuselage, none of the modifications tested eliminated the difficulties;

3) A long symmetrical fuselage increased the Mach number at which the adverse diving moments occurred by at least 0·05. At Mach numbers up to at least 0·75, the limit of the tests, the long symmetrical fuselage caused the [aircraft] to balance at a sufficiently positive



NASA

ABOVE ***The 1/8th-scale Lightning model provided by Lockheed, under test with a lengthened fuselage in the 16ft high-speed windtunnel at the NACA Ames Laboratory in California in 1942. The similarity to the configuration of Lockheed's modified "Swordfish" high-speed research P-38 variant, which emerged shortly afterwards, is striking.***

lift coefficient [see glossary] *so that recovery from dives could be effected;*

4) The longitudinal manœuvrabilty of the {aircraft] at high speeds can be improved by the use of the long symmetrical fuselage. For example, at 25,000ft [7,600m] and a Mach number of 0·65, the [aircraft] can obtain 2·5g accelerations, as compared with only 1g for the standard configuration."

NACA's account also includes the following intriguing comment: "The recommendations were good in theory but would have required major modifications to the design. Kelly Johnson would have none of them".[17] Despite the solution coming this time from high-speed tests as insisted upon by Lockheed, it seems that this was, once again, the "wrong answer".

In April 1943 yet another report from NACA on the Lockheed fighter appeared, also written by Erickson. Its introduction reads: "A change in the shape of the fuselage was recommended in [Erickson's earlier report], but the results did not indicate that it would overcome the objectionable pitching moments at all lift coefficients. Therefore, the model was returned to Ames at the request of NACA, to investigate the effect of auxiliary flaps, a controllable stabiliser and change of wing contour upon the diving characteristics in an endeavour to provide adequate control".[18]

This new reason for the rejection of the design alteration is odd, as nowhere in Erickson's earlier report is it mentioned that it did not cover all lift coefficients. The relevance is questionable, as lift coefficients go out of the window with the onset of compressibility effects on an asymmetric aerofoil; indeed, that was the whole problem. Nevertheless, Erickson and NACA had been asked to come up with something else. Lockheed eventually settled on the proffered "auxiliary flaps" solution, which, incidentally, would have been the cheapest.

This solution worked by changing the pressure field around the wing. It was something of a "workaround", in that it did not address the aerodynamic shock, but merely changed some of the forces, essentially placing a balancing shock beneath the wing, such that the aircraft's nose was not pitched so violently downwards.

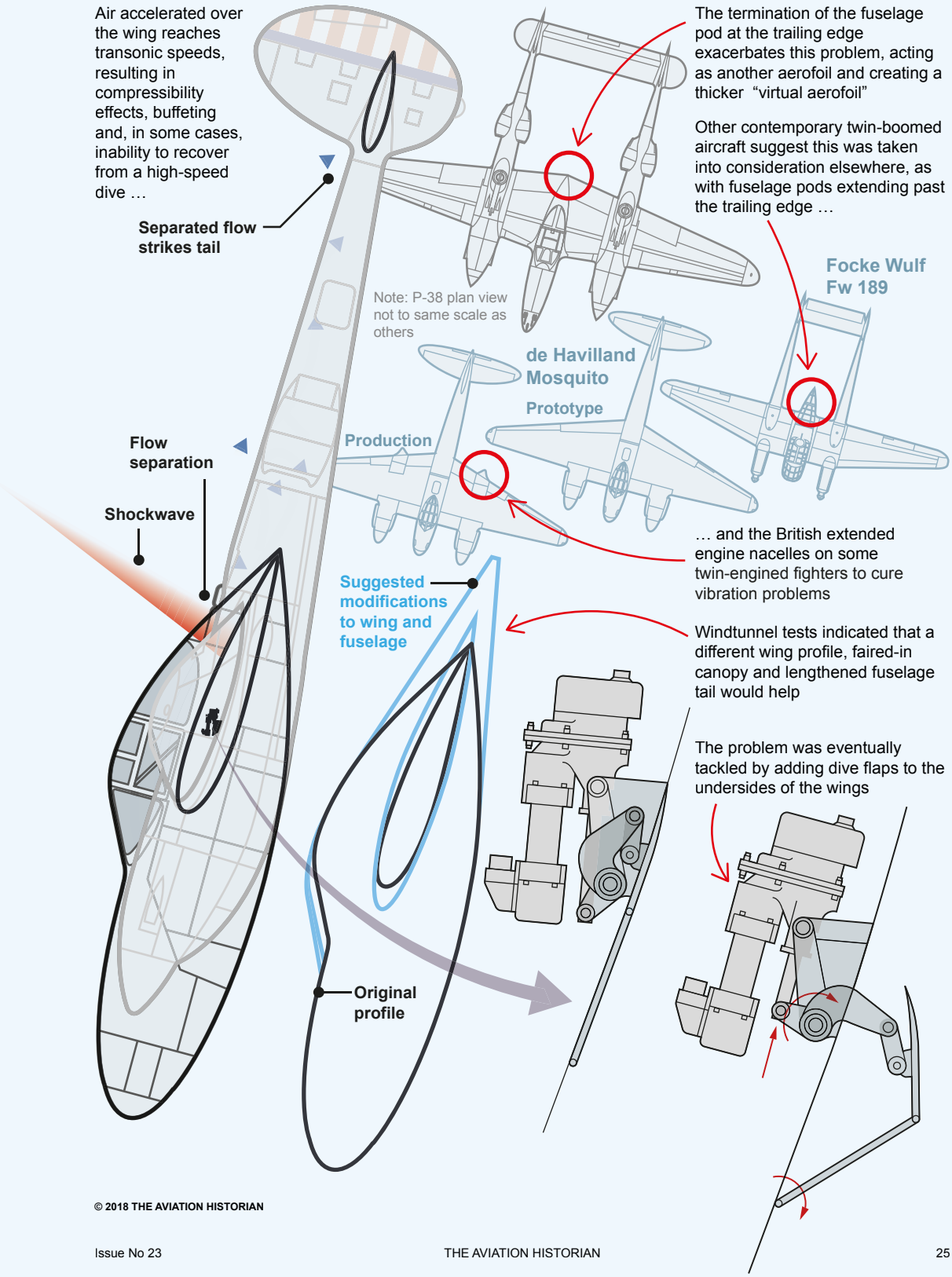
Stack's team had first tested such flaps as a solution in March 1942. Stack later wrote the following as part of his 1945 publication *Compressible Flows in Aeronautics*:

"The original investigation with an [aircraft] model was based first on tests made on a wing alone, with a simulated split trailing-edge flap, in the NACA 24in (0·6m) high-speed windtunnel. These results were then applied to the complete [aircraft] model in the NACA 8ft high-speed windtunnel. The results were as expected, the

The P-38 and compressibility

The problem

Air accelerated over the wing reaches transonic speeds, resulting in compressibility effects, buffeting and, in some cases, inability to recover from a high-speed dive …



Seeking a solution

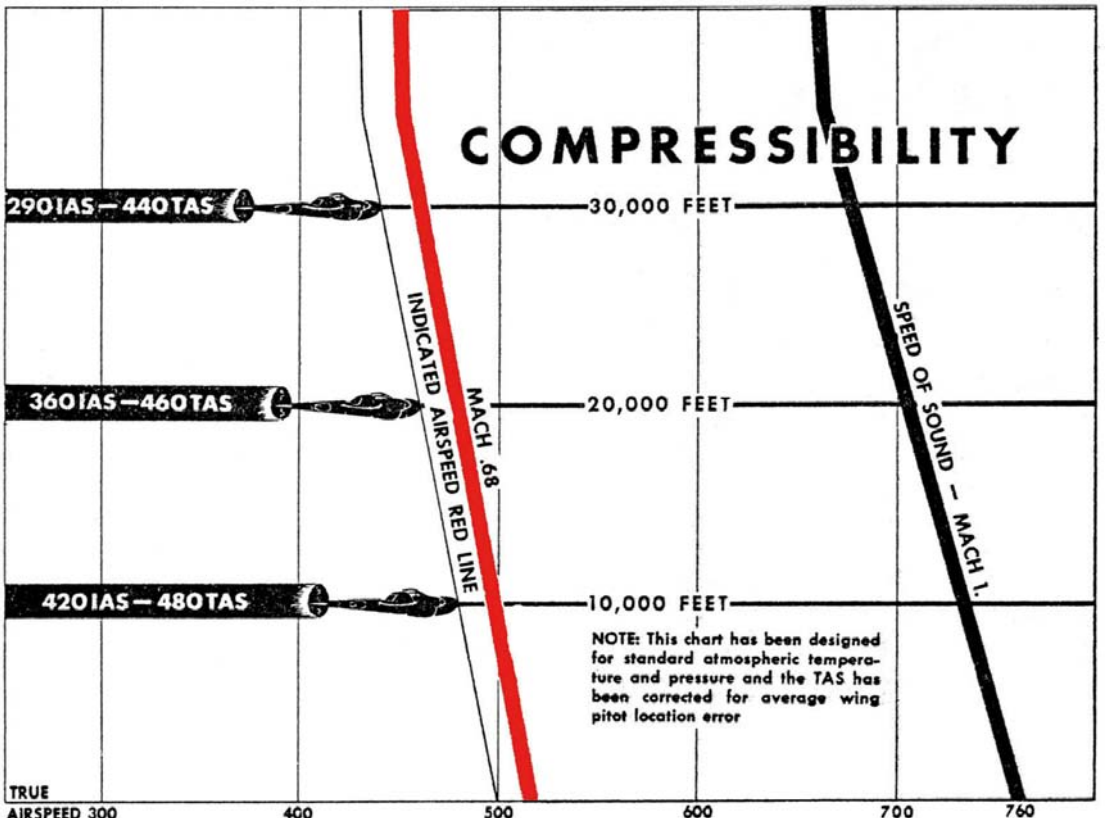
The termination of the fuselage pod at the trailing edge exacerbates this problem, acting as another aerofoil and creating a thicker "virtual aerofoil"

Other contemporary twin-boomed aircraft suggest this was taken into consideration elsewhere, as with fuselage pods extending past the trailing edge …

… and the British extended engine nacelles on some twin-engined fighters to cure vibration problems

Windtunnel tests indicated that a different wing profile, faired-in canopy and lengthened fuselage tail would help

The problem was eventually tackled by adding dive flaps to the undersides of the wings



NASA

ABOVE ***The P-38 struggled throughout its service career to exceed M0·6 in level flight, despite the suggestion of unrealistic level speeds in this USAAF pilot's training manual. Interestingly, M0·6 was identified by Guryansky and Preston as the whole-aircraft critical Mach, while the red-line M0·68 shown here was in fact that of the wing alone.***

necessary increase in wing lift being produced. A disadvantage was, as could be expected, some increase of tail load. The investigation was then pursued at Ames, and flaps forward on the lower surface of the wing were developed which produce the desired lift increase without as large an increase in tail load as is obtained with trailing-edge flaps."[19]

Ames had used its new 16ft (4·9m) high-speed windtunnel to test for the optimum flap position, and this work fed into the paper by Erickson and the final design of the P-38's dive flaps. Despite Ames having a flight-test facility and a test P-38 on-hand, Lockheed apparently insisted that the manufacturer perform the first real-world testing of the new flaps out of nearby Burbank, giving the risky job to test pilots Tony LeVier and Milo Burcham from late February 1943.

In his memoirs, Ames-based flight test engineer Seth B. Anderson recalls the testing:

"As a curious young engineer, I asked why Ames pilots were not allowed to explore the higher-speed part of the flight envelope to determine the cause of, and find a possible solution for, the [P-38's] serious control problems. Although not officially disclosed, it was rumoured that the chief designer of the aircraft did not want NACA to disclose publicly the serious high-speed deficiencies of this aircraft. Consequently, Ames's flight-test airspeeds were limited by edict from the engineer-in-charge to Mach 0·65, to downplay the control problem caused by compressibility effects." Anderson continues:

"As speed increased to Mach 0·74, the diving moment exceeded the ability of the [tailplane] to effect a recovery. This dive behaviour seriously restricted operational use of the P-38 in combat. Other contemporary fighters, for example the [Bell] P-39 or the P-47, which had thinner wing sections, could penetrate the transonic flow region with less serious recovery problems. The Army Air Forces asked both Langley and Ames to find an acceptable solution for this difficult problem. Model tests in the Ames 16ft high-speed windtunnel suggested a quick and easy fix by adding flaps on the lower surface of the wing at 33 per cent chord to offset the loss in lift caused by shock-induced flow separation. This partly helped the problem. Again, Ames was not permitted to flight-test this recommendation because Lockheed wanted full credit for improving a basic design deficiency.

"Political considerations sometimes dominated Ames's flight research contributions. The company team of aircraft designers did not foresee that using a 16 per cent [aerofoil] section in

PHILIP JARRETT COLLECTION

ABOVE ***Kelly Johnson and Lockheed test pilot Milo Burcham discuss the dive-flaps on a P-38 in one of a series of posed photographs of Lockheed personnel with the flaps, designed to reinforce the notion that the flap was a Lockheed idea; it was in fact the result of research undertaken by NACA at Ames. Burcham was killed in the third prototype YP-80 in October 1944.***

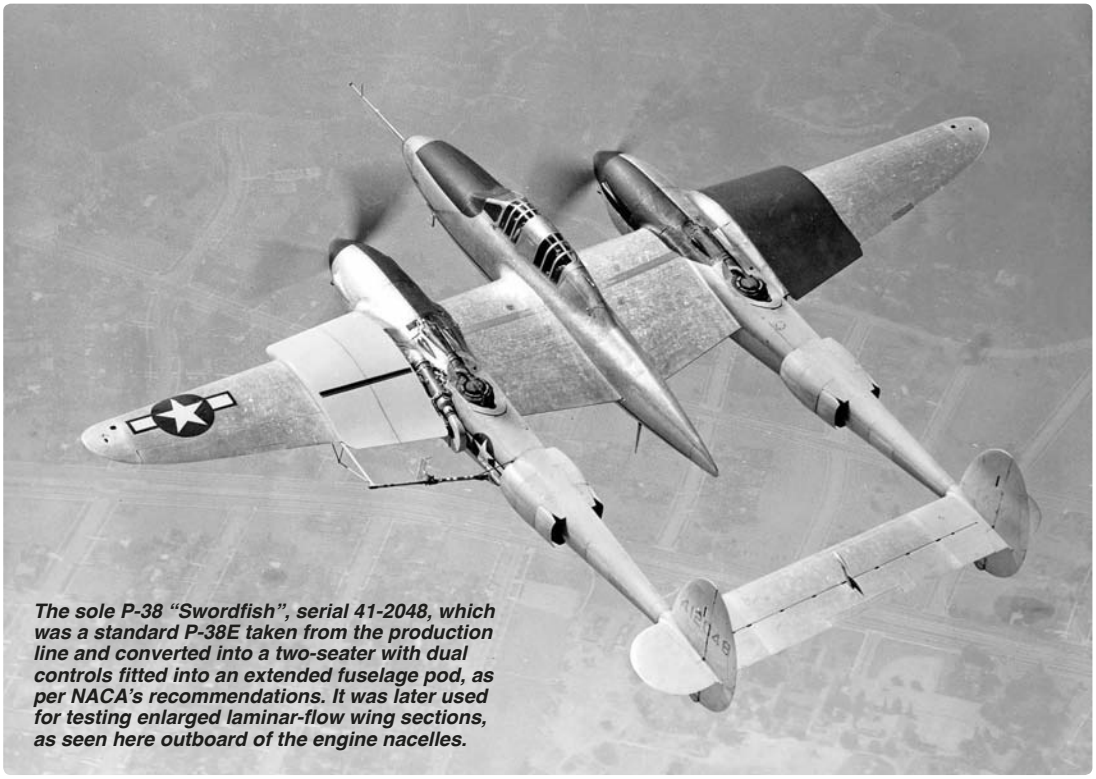
proximity to a bulbous canopy and large engine nacelle would exacerbate flow separation that could not be eliminated without a major redesign".[20]

Lockheed's corporate management, with the apparent co-operation of government agencies, allowed a further bending of the truth, almost to breaking point. In Johnson's own memoir the designer says: "Later NACA did do some testing on its own but had contributed nothing to solving the problem of compressibility on the P-38, except allowing the use of its windtunnel".[21]

TACIT ACKNOWLEDGMENT

Notwithstanding Johnson's public claims, a quiet acceptance of the rightness of the criticisms from the likes of Draley and Anderson is demonstrated by the shape of the so-called P-38 "Swordfish", which made its first official flight in June 1943, but which was photographed on the ramp at Burbank in 1942. It also shows that, despite these revisions being labelled "major modifications" by NACA, Lockheed (famous for its fast turnaround times) could have redesigned the P-38 fuselage in short order — because it did.

According to British weekly magazine *Flight*, the "Swordfish" was built for dive tests (for which there are no available records), but by the time the well-known series of photographs of it was taken it had become a testbed for high-speed



The sole P-38 "Swordfish", serial 41-2048, which was a standard P-38E taken from the production line and converted into a two-seater with dual controls fitted into an extended fuselage pod, as per NACA's recommendations. It was later used for testing enlarged laminar-flow wing sections, as seen here outboard of the engine nacelles.

TAH ARCHIVE

laminar-flow aerofoils.[22] This was possible only because the aircraft could now be dived at high speed without the "quick-fix" flaps, which would have sat exactly where the test aerofoil section cuffs were located, although this was never acknowledged by Lockheed. This early "Skunk Works" testbed does look remarkably similar to the solution recommended by Erickson's first paper and also NACA's earlier full-scale test suggestion from its Langley facility, both of which Lockheed called "unacceptable".

Johnson's autobiography includes the following assertion: "We decided that if we could not solve compressibility, we could discover a way to slow the [aircraft] to a speed where the effect no longer was a factor. The answer was external dive flaps or brakes". This is both a disingenuously inaccurate description of the function of the flaps that some claim were of Johnson's own design, and something of a canard. Why? It can only be that Johnson was dissembling for a reason. Whatever else might be said of him, he was a loyal company man who would muddy any waters necessary. An aircraft that was just too fast and needed to be slowed looked better than the alternative.

It is not true that he was one of the few people in the world who understood compressibility when he designed the P-38. This common assessment completely ignores the thousands involved in propeller theory and design who had been wrestling with aerofoil behaviour at critical Mach for years. Any aircraft designer would be aware that if the aircraft went fast enough, the wing would hit critical Mach. It did not take a "design genius" to say that, as Johnson quite rightly did.

Very few, however, understood how a body and wing really behaved together close to critical Mach. The general observations of exactly that by James Delano in 1939 were not released until 1943 and the P-38-specific observations of Draley not at all, even to this day. Nevertheless most designers would avoid anything that tended towards flow separation, as the P-38's distinctive pod fuselage did. The oversight — very possibly not Johnson's — was inexplicable, and it may just be that not changing the fuselage and finding an alternative fix saved Johnson from trying.

LOCKHEED'S "BURIED" EXPERIMENTS

Also running counter to the "official" version of events is the work that Lockheed itself undertook to correct the design. While the leading-edge fillets were under development in the autumn of 1941, there was a discreet parallel project undertaken to redesign the fuselage pod at the trailing edge, according to Bodie in *Lockheed P-38 Lightning: The Definitive Story* (Widewing Publications, 1991). Bodie appears to have enjoyed a remarkable level of access while Lockheed records were still kept at Burbank, rather than the record-management facility where they now reside. Two aircraft were modified in 1941 along lines that demonstrate a very early understanding of the real problem — and the real solution. Bodie writes:

TAH ARCHIVE

LEFT ***By the end of 1943, Johnson had turned his attention to the development of the USA's first jet fighter, the P-80; he is seen here with a model of it. Johnson went on to lead the design teams on many highly innovative aircraft over the next four decades, including the F-104 Starfighter, JetStar business jet and the U-2 and SR-71 spyplanes.***

"[Lockheed] reworked the aft fuselage of [serial] 40-747, extending the body about 1ft [0·3m] beyond the trailing edge of the wing. That same type of modification was incorporated on the first Lightning I (Model 322-61-04), in September to help speed up the flight test program. Bearing the RAF serial number AE978, the aircraft was heavily endowed with tufts for airflow analysis."

The practical argument that the war effort could ill-afford delays to P-38 production when the long-fuselage solution emerged is undermined by these seemingly buried earlier experiments. There was no pressure for war production in the autumn of 1941, but there was a balance sheet, with a substantial hole in the budget caused by the British refusal to pay for an aircraft that shook at speed — and the beginnings of an image problem.[23] Ben Kelsey himself alluded to the financial imperatives that drove the search for an "acceptable" solution.[24]

No public records of these 1941 experiments, conducted while Johnson was head of the experimental flight test division, now seem to be available beyond the very specific data documented by Bodie. There is a blurred image in part of a Lockheed photograph of another subject in Bodie's book showing one long-fuselage P-38 on the experimental flight line in March 1942. These two modified aircraft could have provided a solution that would have saved public money and the valuable resource that was the NACA team and facility, which devoted itself at a critical time to solving a life-threatening problem that had in fact already been solved.

All these factors — Lockheed's apparent early knowledge of the issue; NACA's tireless and painstaking windtunnel work at the expense of other vital research; Stack's flap workaround and Erickson's perfection of it — must be held up against the common version that NACA delayed a "solution to compressibility" while Lockheed finally found it. Sadly, this has never been properly countered with the facts by either NACA or Kelly Johnson.

CAREFUL PHRASING

Johnson did prepare a paper for presentation to the Institute of Aeronautical Sciences in New York in January 1943, summarising the lessons learned from the P-38. It is a detailed and fairly technical treatment of compressibility effects, in which he states (contrary to his autobiography) that limiting speeds to avoid compressibility "is not acceptable".[25] He rightfully received universal praise for a work that would be of great benefit to other manufacturers and which significantly advanced high-speed flight.

In the paper Lockheed's dive tests are discussed and a lot of NACA's work is presented, as well as experimental changes to wing camber, the use of slots, flaps and "bumps" in wing profiles. The glaring omission is the work on fuselage shape which had proved so effective. Johnson said that the paper was declared "Secret" by the military, and that copies had to be recalled from circulation for amendment. Curiously, the associated correspondence on file states that it was the War Department's public relations office that objected, not those concerned with national security.

Also in the correspondence is Johnson's reply to RAE Farnborough's G.P. Gordon, one of the pioneers of compressibility theory in the 1920s, who had sent a suggestion to help with the P-38 problem, frustratingly redacted from his personal letter to Johnson in the Huntington Library record. Johnson's response is interesting:

"On January 25 [1943] I am publishing a carefully phrased discussion on the above subject at the Institute of Aeronautical Sciences' annual meeting. While I was not free to discuss specific aircraft or some of the 300-plus modifications we have tested, I have tried to sum up the outstanding experiences we have had to date."

Johnson having to phrase things "carefully"

suggests there were all kinds of sensitivities at play, although a spy could easily guess which high-speed fighter Lockheed was testing in 1941.

In 1945 John Stack was invited to give his prospective paper on compressible flows at the Eighth Wright Memorial Lecture in Washington DC. For this he also updated Eastman Jacobs's 1935 Volta presentation, with film of windtunnel tests on aircraft instead of photographs of aerofoils, and with direct reference to the intervening decade of practical experience. Again he showed that subsonic separation and early supersonic shock were from the same sources, inter-related and exacerbated by the same factors. He talked of his work on the P-38 and mentioned the flaps as his own imperfect solution, improved by the NACA Ames team. Interestingly, he passed over the earlier, safer and more effective (higher speed, lower drag) elongated fuselage solution, despite it upholding his thesis, as if it had never happened at all rather than actually having been established at least three times, twice in his own organisation's windtunnels.

The evidence was there to show what was really happening with the P-38, and it was put in front of Johnson and Hibbard, both very able to assimilate and make engineering decisions based on both insight and intellect. There were clear proposals for specific changes that would make the production aeroplane faster and safer at least as early as March 1942, probably only echoing an insight that Johnson had already gained from his own department's flight experiments in 1941. These were not acted upon by Lockheed except in building an aeroplane for its own purposes. Its reasons for this must remain purely conjecture.

As an echoing postscript, it is perhaps worth noting that in more recent times a great deal of money and effort has been invested in ironing out technical problems with an ambitious aircraft that is "too big to fail": the Lockheed Martin F-35 — officially named Lightning II.

ACKNOWLEDGMENTS *The Editor would like to thank Dr Richard P. Hallion for his invaluable assistance with the preparation of this article*

ENDNOTE REFERENCES

1 Reported conversation, *Flying* magazine (USA), September 1977
2 Jacobs, Eastman N., Ward, Kenneth E., *Interference of Wing and Fuselage from Tests of 209 Combinations in the NACA Variable-Density Wind Tunnel*, NACA Report 540, 1937
3 Jacobs, Eastman N., *Methods Employed in America for the Experimental Investigation of Aerodynamic Phenomena at High Speeds*, Reale Academia d'Italia imprint on behalf of NACA, 1935, NASA Archive
4 Johnson, Clarence L., *Investigation of Tail Buffeting Conditions on Lockheed P-38 Airplane*, Lockheed Report No 2414, 1941
5 Bodie, Warren M., *Lockheed P-38 Lightning: The Definitive Story*, Widewing Publications, 1991
6 Ethell, Jeffrey, *P-38 Lightning at War*, Ian Allan, 1978
7 Ethell, Jeffrey, *P-38 Lightning*, Crown Publishing Group (NY), 1983
8 US National Archives, Whirlwind correspondence
9 Lange, Roy H., *A Summary of Drag Results from Recent Langley Full-Scale Tunnel Tests of Army and Navy Airplanes*, NACA Advance Confidential Report L5A30, 1945, Table II
10 Mair, W.A. (Ed.), *Research on High Speed Aerodynamics at the Royal Aircraft Establishment from 1942 to 1945*, Aeronautical Research Council R&M 2222, 1946
11 Gray, George W., *Frontiers of Flight — The Story of NACA Research*, Alfred A. Knopf, 1948
12 Guryansky, Eugene R., Merritt Preston, G., *Investigation of Buffeting and Diving Tendencies of the YP-38 Airplane*, US Army Air Corps, 1942
13 Chambers, Joseph R., *Cave of Winds*, NASA 2014
14 Merritt Preston, G., Interview with Carol Butler, NASA Johnson Space Center Oral History Project transcript, 2000
15 NACA Washington DC Archive, correspondence with author
16 Erickson, Albert L., *Investigation of the Diving Moments of a Pursuit Aeroplane in the Ames 16ft High-speed Wind Tunnel*, NACA memorandum Report, October 1942
17 Hartmann, Edwin P., *Adventures in Research — A History of Ames Research Center 1940–1965*, NASA, 1970
18 Erickson, Albert L., *Wind Tunnel Investigation of Devices for Improving the Diving Characteristics of Airplanes*, NACA Memo Report 3F12, April 1943
19 Stack, J., *Compressible Flows in Aeronautics*, Eighth Wright Brothers Lecture, Journal of Aeronautical Sciences Vol 12, No 2, April 1945
20 Anderson, Seth B., *Memoirs of an Aeronautical Engineer: Flight Test at Ames Research Centre 1940–1970*, Historical Monograph #26, NASA 2002
21 Johnson, C.L. and Smith, M., *More Than My Share Of It All*, Smithsonian Institution Press, 2012
22 *Flight*, November 29, 1945, *Theory in Practice — P-38 Specially Equipped for High-Speed Aerofoil Tests*
23 Bailey, Gavin J., *Arsenal of Democracy: Aircraft Supply and the Evolution of the Anglo-American Alliance*, Edinburgh University Press, 2013
24 Kelsey, Benjamin S., *The Dragon's Teeth? The Creation of United States Air Power for World War II*, Smithsonian Institution Press, 1982
25 Johnson, C.L., *Compressibility Effects on High Speed Aircraft*, paper for the Institute of Aeronautical Sciences, New York. Lockheed Aircraft Corporation, 1942

Mike Hooks

1929–2018

The enthusiast's enthusiast

In January this year Mike Hooks, founder member of Air-Britain and perennial champion of all things aeronautical, died aged 89. We remember a friend and former colleague whose unstinting passion for aviation was matched only by his encyclopædic knowledge of the subject — **NICK STROUD** pays tribute to a lifelong influence and personal mentor

IT WAS WITH enormous sadness here at *TAH* that we heard that our old friend and erstwhile colleague Mike Hooks had died aged 89 on January 17. Mike was one of the most dedicated aviation enthusiasts we've had the pleasure of working with and was unstinting in his commitment to documenting the subject for which he had such an all-encompassing passion. He was endlessly encouraging and helpful to those of us following in his footsteps, and something of a mentor for me personally, as well as for numerous others now plying their trade in the world of aviation.

An early developer

Born in Chichester, West Sussex, on September 23, 1928, Mike loved to recall that his first "spot" was the mighty LZ127 *Graf Zeppelin* airship over the South Coast during one of its visits to the UK during 1931–32, while Mike was still very much in short trousers. It nevertheless clearly made an impact on the young spotter-in-training and fired a lifelong ambition to note — and later photograph — every aircraft he came into contact with, or even just witnessed at a distance. All too often when talking to Mike, one might see the faintest trembling of those prodigious ears, perfectly designed to pick up the distinctive burr of an aero-engine at five miles, followed by a skyward tilt of the head, guided by his unfailing inbuilt homing radar; binoculars would be produced from nowhere in an instant, and the dot high overhead identified and noted in the "copbook" always kept close at hand.

Mike produced a number of books including the ever-useful* 40 Years at Farnborough *with noted commentator John Blake.

It was a technique honed while part of the Royal Observer Corps, a civilian volunteer organisation established for the visual detection, identification and tracking of aircraft over the UK, and which, it is often forgotten, provided valuable services for the government during the height of the Cold War. It was also the perfect environment in which to meet like-minded aviation-mad individuals, one of which was my late father, Mike Stroud, the pair going on to become partners-in-crime at airshows and events all over the world for the next 60 years.

In 1948 Mike became a founder member of Air-Britain and went on to be a leading member of the Air-Britain Council and Editor of *Air-Britain Digest* during 1964–73. In 1967 he was appointed Editor of *Airports International*, the official journal of the International Civil Airports Association; this gave him plenty of opportunity to indulge his passion for aviation photography, which had begun in 1945 with a simple box camera.

By the late 1950s Mike had become one of the few enthusiast photographers documenting his travels in colour (nearly always Kodachrome; he experimented with other brands but quickly became a staunch advocate of the far superior Kodak product, happily for future generations).

Mike left *Airports International* in 1973 to take up a new position as an Information &

LEFT ***A familiar pose for one of the UK's most prolific aviation photographers; this self-portrait of Mike and one of his early cameras was taken in the late 1940s or early 1950s. Thanks to Ben Dunnell at*** **Aeroplane** ***for his kind assistance with the preparation of this tribute.***

Statistics Executive at the Society of British Aircraft Constructors (SBAC), which led to his appointment as Press Relations Officer at the organisation's biennial trade show and air display at Farnborough.

John who?

It was here that Mike forged something of a legend for himself when, in the late 1970s, John Travolta, at the time a film megastar of the first order (and himself a keen aviation enthusiast) turned up "on spec" at the Farnborough gate, hoping to parlay his celebrity into a free pass into the show. When told that *the* John Travolta was at the gate, Mike, a diehard classical music fan oblivious to the charms of *Saturday Night Fever*, responded with "John who? Never heard of 'im!" and sent him away with a flea in his ear.

After his retirement, Mike found his encyclopædic knowledge much in demand, and he soon found a home at IPC's aviation history title *Aeroplane Monthly*, as *TAH* Managing Editor and former *Aeroplane* Editor Mick Oakey, recalls:

"It must have been sometime during the early 1990s — after I had been on *Aeroplane* for about ten years as Assistant Editor — that the pressure of compiling and editing the magazine's ever-expanding newspages meant that I needed help with other editorial duties such as sub-editing and proofreading. Hence we called on well-respected old hands Phil Jarrett for the subbing, and Mike Hooks for the proofreading, each doing one freelance day a week in our office. Mike quite often used to spot proofing errors I had missed, which hurt my pride a bit, so at first I regarded him as an infernal nitpicking nuisance. But I soon came to appreciate that an infernal nitpicker was exactly what we needed — and Mike's status as a national treasure was cemented, for me, on the day he was proofreading an aircraft-production data-table (considerably less engaging than a phone directory) and piped up, "that doesn't look like a de Havilland Vampire serial number to me".

"Thus, when we wanted to introduce a questions-and-answers page into *Aeroplane*, Mike was the perfect candidate to run it. His first page, with no byline, appeared in our August 1995 issue, under a frightfully clever heading I had dreamed up, *Questions in the Air*. During various redesigns the page morphed into the rather more obvious *Information Exchange* (by which time Mike had a byline) and finally the what-it-says-on-the tin *Q&A*. In all that time, Mike could be left to get on with it, in the sure knowledge that he would come up with the goods; an Editor's dream. During the 2000s he even embraced working on a computer, after decades as a strictly traditional typewriter-only man — just one example of curiosity about new things getting the better of him. In my view it was his boundless curiosity, and utter (sometimes alarming) fearlessness in asking awkward questions, that made him a brilliant journalist and an example to the rest of us."

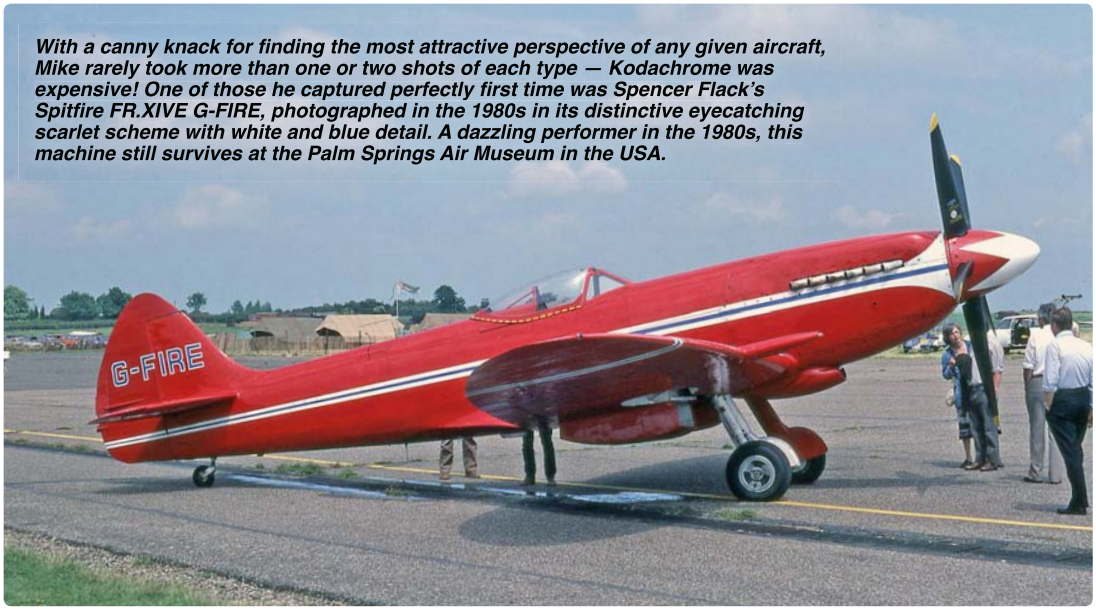
Having known Mike all my life — he was best man at my parents' wedding before I was born — I was delighted to work with him when I joined Mick at *Aeroplane* in 2000 (which Mike had been partly responsible for). Intriguingly, as my fellow former *Aeroplane* colleagues will remember, there was one enduring mystery we never got to the bottom of; before starting any piece of work he would adjust his seat and say "woof!". None of us ever thought to ask . . .

Over the next few pages we present some of Mike's magnificent photographs as a tribute to this irrepressible enthusiast, one of aviation's "true believers".

One of the few British aviation enthusiasts to start regularly using Kodachrome in the late 1950s and early 1960s, Mike made sure to focus on the more unusual and colourful types on his travels, including the Max Holste MH-260 Super Broussard prototype, F-WJDV, which he photographed at the 1961 Paris Air Salon in Royal Air Maroc colours. Powered by a pair of Turboméca Bastan IV turboprops, the type first flew in July 1960 and became the blueprint for the pressurised Nord 262.

ABOVE *Mike's early stamping ground was Croydon, where in 1959 he photographed Consolidated PBY-5 Catalina N5593V, which had arrived for repairs after filming sequences for Richard Attenborough vehicle* **SOS Pacific** *in Madeira.* **BELOW** *Before becoming its Press Relations Officer in 1973, Mike was a regular visitor to the SBAC show at Farnborough, where he took this magnificent shot of the Royal Navy's Fairey Swordfish LS326 in 1962.*

With a canny knack for finding the most attractive perspective of any given aircraft, Mike rarely took more than one or two shots of each type — Kodachrome was expensive! One of those he captured perfectly first time was Spencer Flack's Spitfire FR.XIVE G-FIRE, photographed in the 1980s in its distinctive eyecatching scarlet scheme with white and blue detail. A dazzling performer in the 1980s, this machine still survives at the Palm Springs Air Museum in the USA.



ABOVE & BELOW *One of Mike's particular passions was unusual light aircraft, the more obscure the better; fulfilling this criterion perfectly was Austria's twin-engined Simmering-Graz-Pauker M.222 Flamingo, the third prototype of which Mike photographed at Paris in 1961, along with colourful examples, below, of Dornier's Do 27 and Do 28.*

ABOVE ***Again showing Mike's gift for composition, context and colour, this Kodachrome of de Havilland Heron 1B G-ANXB, named*** **Sir James Young Simpson,** ***of BEA's Scottish Airways division, was taken on the apron at Glasgow's Abbotsinch Airport in August 1971. The aircraft was being prepared for its next flight to the beach at low tide on the Hebridean island of Barra.***

RIGHT ***With wings folded, one of the West German company*** **Deutsche Luftfahrt Beratungsdienst's** ***distinctive scarlet Hawker Sea Fury T.20s awaits another target-tug flight at Lübeck-Blankensee in the late 1960s.***

BELOW ***Some types are more photogenic than others, a fact Mike used to good advantage when in the perfect spot on the terminal roof at Liverpool's Speke Airport to photograph Vickers Viscount 701C G-ANHA in 1961. Note the 11th window added at the rear of the cabin when 'NHA was converted to a high-density configuration in 1959.***

WHITEHALL & THE FAIREY ROTODYNE

A VERY LARGE & AWKWARD BABY

"No aircraft has proved a more difficult subject than the Rotodyne . . ."[1]

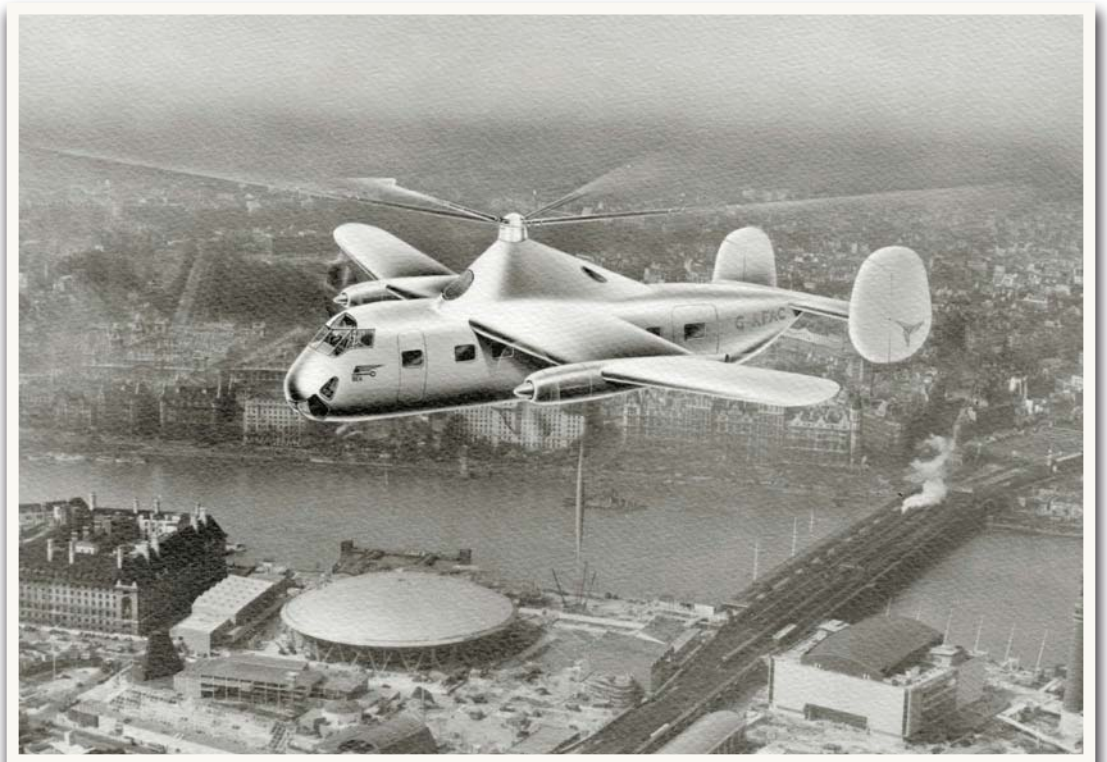
Continuing his series on the political aspects of some of the British aviation industry's most significant and far-reaching post-war adventures, **Prof KEITH HAYWARD FRAeS** uses official papers and contemporary documents to examine the bureaucratic nightmare that plagued the development of the innovative — but very, *very* noisy — Fairey Rotodyne

AT THE END of the Second World War the British Ministry of Supply (MoS) sought to boost the nation's rotary-wing industry through money for research and the promise of a "protected" domestic market. Several companies, including Fairey Aviation, took up the challenge and began to develop their own helicopter designs. For all this effort, British customers, both civil and military, were often drawn to the more successful American designs built under licence in the UK by Westland.[2] But at least once during this period the UK appeared to possess a world-leading product — the Fairey Rotodyne. For a brief period, along with the supersonic transport (SST), it was the centrepiece of the government's aeronautical research policy. When cancellation came in 1962, however, it was the result of inconsistent official support and a failure to win firm orders from the nationalised short- and medium-haul airline, British European Airways (BEA).

INITIAL DEVELOPMENT, 1949-55

The direct descendent of the company's record-setting Gyrodyne and Jet Gyrodyne technology demonstrators of the late 1940s and early 1950s, the Rotodyne was designed to carry 40 passengers directly between city centres. Also promoted as a military transport, the Rotodyne came to be viewed as a potential "worldbeater".

THE SOLE ROTODYNE AT FARNBOROUGH, 1958.
MIKE STROUD / TAH ARCHIVE



PHILIP JARRETT COLLECTION

ABOVE ***This promotional Fairey item shows an artist's impression of an early incarnation of the Rotodyne superimposed on a photograph of the Dome of Discovery on London's South Bank during the Festival of Britain, suggesting this is probably a 1951-vintage proposal. The original design, to be powered by Armstrong Siddeley Mambas, was put forward in 1948.***

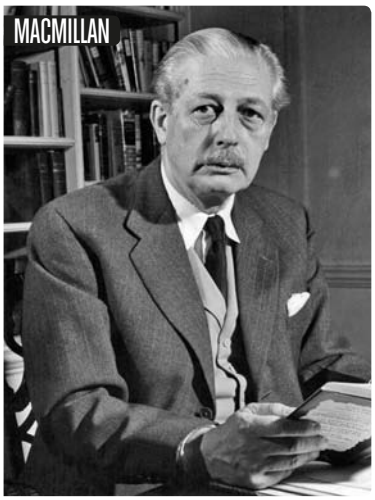
Its key feature was "convertibility": namely its ability to fly conventionally to some degree, with each wing fitted with a turboprop engine; but, for take-off and landing, to use a rotor driven by tip-mounted jet units — a lighter and more effective configuration than conventional helicopter design.[3] The Ministry of Defence (MoD) funded early work on the project, which was led by Fairey, with powerplant manufacturer Napier (which had become part of English Electric in 1942) developing a variant of its Eland turboprop engine. But with several front-line military projects under pressure, the Air Ministry was reluctant to commit heavily to the programme.[4]

There was, however, a possible civil requirement for the Rotodyne, as BEA had begun to consider a response to Belgian national airline Sabena's plans to inaugurate inter-city helicopter operations. This led the Ministry of Transport & Civil Aviation (MoTCA) to urge the MoS to develop a civil Rotodyne.[5] This released funding for a second prototype on July 3, 1954. But this was hardly the scale of support needed to move the project towards production. The MoTCA minister (Alan Lennox-Boyd until July 1954, when John Boyd-Carpenter took over) conceded that the MoS had tried its best to secure adequate funding and that he had "no intention of blaming anybody for the present situation; this, however, shows alarming symptoms which the government might be called upon to account for".[6]

Matters came to a head in late 1955 when the military research and development (R&D) budget for helicopters was halved; with no definite requirement from the Air Ministry, the MoS had to drop the Rotodyne from the military development programme and had to reclassify it as entirely a civil project. Progress now depended on obtaining a firm order from BEA. In July 1956 the Minister of Supply, Reginald Maudling, wrote the following to the Minister of Transport & Civil Aviation (by this time Harold Watkinson):

"I have at the moment no authority from the Treasury, nor do I think it likely that I could obtain it. The military [has] declared no further interest, leaving just BEA's general interest. Consequently, would BEA or [the MoTCA] have any objection to the discontinuance of this project?"[7]

The view expressed in Maudling's letter came as something of a surprise to BEA; its chairman, Lord Douglas of Kirtleside, asserted that the Rotodyne was the only helicopter under development that could meet BEA's needs, promising better operating economics than any alternative, and that its cancellation would abandon the field to



the Americans.[8] Nevertheless, BEA's interest remained vague, hinting only at a preliminary order for four, but with the prospect of 20 options.

Maudling was sceptical: "Even if BEA can place a conditional order, it will still leave us and [Fairey] holding a very large and awkward baby". Watkinson was by now a strong champion of the Rotodyne; writing directly to Chancellor of the Exchequer Harold MacMillan, he stated that this was a risk that ought to be supported by the government. It was the only British design capable of competing with the Americans, and it was unfair to expect BEA to support civil helicopter development, which was still in its "early stages".[9]

It appears that the pressure from Watkinson and Lord Douglas paid off. Within a month, the Treasury was complaining that the MoS had changed its tune over the Rotodyne: "The Service departments have sloughed off from the defence R&D programme a number of projects which may be good in themselves, such as the Rotodyne. The Minister of Supply is now pushing those projects regardless of his main thesis of a few months ago, that his ministry cannot economically spend more than about £170m on R&D".[10] The aircraft industry was already claiming a benefit, i.e. direct support for civil prototypes, not available to other industries, and rejection was advised.[11] These sentiments were echoed by MacMillan: "I should perhaps warn you from what I have heard and read so far, that I am not sympathetic to the idea of continuing Exchequer assistance to Fairey for the Rotodyne."

The aim of current policy was to reduce the level of R&D devoted to defence and to redistribute resources to other sectors. Macmillan continued:

"It does not help if we simply take one item of expenditure from one page of the ledger and put it somewhere else. The fact is that we must be increasingly careful how we invest our R&D resources, whether of money or manpower. This means some sort of order of priorities, and I feel very doubtful whether the Rotodyne can rank high on such a list".[12]

Nevertheless, Watkinson won deferral of a final decision for 12 months pending a full presentation of the case for continuing development.[13]

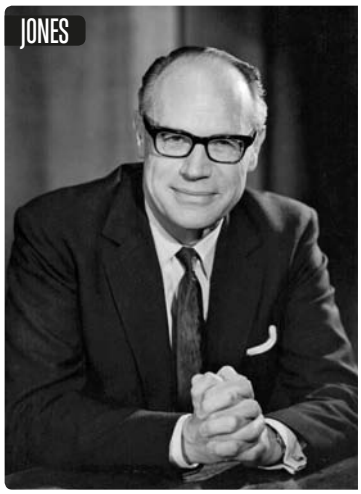
THE ROTODYNE TAKES CENTRE STAGE

What a difference 12 months can make. New leadership in government and a redefined policy on civil aviation R&D gave the Rotodyne a bit of breathing space. In January 1957 Macmillan became Prime Minister, Peter Thorneycroft became Chancellor of the Exchequer (Derick Heathcoat-Amory from January 1958) and Aubrey Jones replaced Maudling at the Ministry of Supply. Watkinson remained at the MoTCA.

Generally, Jones was something of a "hard-liner" on government expenditure and was a strong advocate of privately funded civil aircraft development. However, following the infamous April 1957 Defence White Paper and the cancellation of several military aircraft programmes, Jones was aware of the impact this would have on the aircraft industry. Although still very keen to launch conventional aircraft on the back of orders from the nationalised airlines, he was also minded to support research into promising future concepts such as the Rotodyne.[14] Reluctantly, the Treasury granted another three-month extension to the Rotodyne programme, until December 31, 1957.[15]

By early December the Rotodyne prototype had flown and was making progress, but production targets had slipped to 1961. More critically, noise issues and the need for investment in landing sites were now serious problems, and there were few signs that solutions would be readily available. The Transport Aircraft Requirements Committee (TARC), set up in the early 1950s to discuss such matters, was more positive:

"There is unquestionably a strong case for the continued development of the Rotodyne. If it can be pushed forward energetically to a successful


JONES


DOUGLAS


HEATHCOAT-AMORY

conclusion, this country should be able to seize the initiative in this quite new form of transport".[16]

Douglas, however, admitted being "anxious over the way the Rotodyne is being handled, and its 'hand-to-mouth' financing. I feel strongly that this spending of the taxpayers' money in 'penny packets' on a project of this magnitude is very much against the national interest. BEA has made it clear that the aircraft is a possible way of meeting inter-city requirements. As soon as it comes through the R&D phase we will be in a better position to make up our minds about its potential and consider a production order".[17]

The MoS believed that BEA was now likely to confirm an order for eight or more Rotodynes, and Fairey reported talks with other prospective customers. However, Fairey and Napier were still reluctant to negotiate detailed financial terms covering final development and production. The Treasury was adamant that there would be no more public money until BEA had made a firm commitment and the manufacturers had upped their stake.[18] The MoS and the Treasury eventually agreed to continue support, but to limit it to a further £2m.[19]

By early 1958 the Treasury was exasperated by the evident failure of either supplier (Fairey/Napier) or customer (BEA) to come up with funding. English Electric (Napier's parent company) was adamant about the need for more public support and very reluctant to throw more of its own money at the project. By this time the more powerful Rolls-Royce Tyne was being suggested as an alternative engine; but, while this would improve performance, it would add to costs and seriously delay entry into service. Similarly, "while BEA [has] for some time been ready to express the keenest of interest, [it] shows no readiness at this stage to go so far as to place an order even for as few as four aircraft". The Treasury also wanted to see the noise question resolved, firm orders on the table and increased private funding.[20]

At least the Prime Minister seemed enthusiastic. In a letter to Aubrey Jones, Macmillan wrote: "Please let me have a full report about the Fairey Rotodyne. This seems an exciting project and I would like to know what are its potentialities and possibilities".[21] But there was still little prospect of the companies coming up with more cash, and both Rolls-Royce and Bristol-Siddeley were lukewarm about investing in the programme.[22]

EXCEPTIONAL CIRCUMSTANCES

The options were either to cancel the aircraft or to raise government support. As the Treasury thought he would, Jones stressed the importance of being consistent with declared government policy. While civil projects generally had to be funded by private venture, advanced projects would be considered "on merit" and assistance should be given in "exceptional circumstances". The Rotodyne, Jones felt, was "pre-eminently a case for such treatment. It is a new conception of flight and may on that account prove a winner; but its very novelty involves unusual technical and financial risks."[23]

Harold Watkinson at the MoTCA added his halfpennyworth in the autumn of 1958. As a world-leading concept, he explained, "the Rotodyne could repeat the success story of the [Vickers] Viscount," adding that BEA was "keenly interested in the project and Lord Douglas has told me that if it meets technical specifications, the airline is willing to place a small initial order."[24]

A month passed with no news from the Treasury. Jones wrote again to the Prime Minister: "The matter has now become one of increasing urgency and I, as well as industry, am now in a position of acute embarrassment. The Fairey AGM is close and [the] Chairman needs to know what is happening to the Rotodyne. US operators are also interested and the silence is damaging."[25]

In September 1958 Jones had again written to the Chancellor, Derick Heathcoat-Amory: "I wish now to report that I see no prospect of finding

PHILIP JARRETT COLLECTION

ABOVE ***Unsurprisingly for such a radical new concept, the prototype Rotodyne underwent extensive ground testing before its first flight, accruing some 50hr of rotor trials and 100hr of engine-runs, as seen here with both of its Napier Elands running at high power. Still in its bare-metal finish, the prototype first flew on November 6, 1957.***

the requisite sum privately, the risk involved in bringing what is a novel technical experiment to the point of commercial exploitation being too great in relation to the resources available to the companies. We are faced therefore with a choice either of countenancing an end to the project or of raising the level of government assistance to, say, £4m. To terminate the project would mean putting an end to what was commonly judged to be the most promising venture on show this year at Farnborough, and would probably mean that any completion of the aircraft would be undertaken in the United States".[26]

Jones was again supported by Watkinson, who reaffirmed the growing need for such an aircraft to beat congestion at airports, but who again said that BEA would only order it when technically sound to do so.[27]

TROUGHS AND OATS

The Treasury was not moved. In the view of senior officials, there were still important questions that needed to be answered before it could agree to another £4m. The official went on (in language we would not now expect from a civil servant):

"It is clear that the main n----r in the woodpile is the reluctance of Napier to put a substantial sum at risk in this project. It is of course possible that these horses are not prepared to drink at the same trough. But the MoS already has a substantial bag of oats at [its] disposal by way of incentive."[28]

Treasury officials thought that Fairey would be the "easier firm to squeeze to get to this [£4m] figure since [its] future depends largely on the Rotodyne".[29] Their view was that, as a research vehicle, the Rotodyne would not add any more data than had already been revealed by the Gyrodyne and Jet Gyrodyne: "One must be tempted to feel that the Rotodyne, the Brabazon of helicopters, is like the Baird television, i.e. it works but is fundamentally unlikely to provide the answer to the long-term problem". There were also doubts that anybody was likely to fund the infrastructure necessary to support the aircraft in service.[30]

The Prime Minister's office was also sceptical. As one official noted, "On my own account, I cannot refrain from adding that the sums involved seem colossal. It is really hard for the 'man in the street' to understand how [a cumulative total of] £13m can conceivably have been spent on getting one not-very-large aircraft into the air; or to understand how any firm estimate of how much more money might be needed could be arrived at. Sums of £4m or £6m, or the difference between them, seem to become meaningless. How on earth did we get led into providing £13m and now have to draw a line at which we do not know whether the Rotodyne will be a success or not?"[31]

The Rotodyne still had its supporters. By this time the Minister of Defence, Duncan Sandys felt that a Tyne-powered version was a potentially useful aircraft. In his view, Fairey had done very well to get this far given the difficulties under which it had been working. The Rotodyne was the first of an "entirely new and unorthodox

TAH ARCHIVE

ABOVE ***By this time wearing its blue, white and bare-metal colour scheme and bearing "Fairey Rotodyne" titles and its military serial, XE521, the prototype undergoes a flight in June 1959 in preparation for its appearance at the Paris Air Salon. Important orders from New York Airways and Canada's Okanagan had been placed by this point.***

type" and "is hardly likely to be ordered in quite the same way as a more orthodox project". It was miles ahead of anything else, quicker and safer than a conventional helicopter and "I would regard it as an extremely good bet". He added that government support would be essential to convince overseas customers of its worth, and that the inter-city concept would generate "an enormous requirement". Furthermore, the project that came first would "scoop the pool", and the Rotodyne was "streets ahead".[32]

Jones continued to press for a positive decision, and was keen to stress the wider policy relevance of investing in advanced concepts:

"It has come as a bitter disappointment to me, after the long deliberation which has taken place, to find that the Chancellor has not substantially moved from the uncompromising position taken up by his department well over a year ago. From a short-term perspective, the Chancellor is undoubtedly right; but such a view would ultimately force the UK out of aircraft manufacturing altogether. The Rotodyne is the first test case of our publicly professed determination to maintain our position in the aircraft field by means of government assistance for advanced projects. If we fail to support it, that failure will be publicly regarded as an indication that having willed the end we are not prepared to will the means, and that our policy is not in fact what we said it was."[33]

Watkinson again backed Jones and the MoS. Although BEA was still non-committal, this was understandable given that it was a "revolutionary aircraft". Other potential customers were in the same position. The MoTCA minister was monitoring landing-site infrastructure issues and noted that interest was already being shown by local authorities in the "potentialities of this form of transport; many of them already have sites earmarked; and I feel confident that by the time the Rotodyne is ready to operate commercially there will be enough sites for it to use. Central London has admittedly posed a difficult problem but I have no doubt that a solution will be found".

The real issue, however, was whether the UK would be able to take the lead in a distinctive new form of public transport, or would leave the field clear for American manufacturers.[34]

"A SPOKE IN THE WHEEL . . ."

For the Treasury, the issue was pretty clear-cut: "The conclusion we draw is that the case for spending more money on the Rotodyne is not yet made out; and the further question is bound to arise whether the money for which Mr Jones is asking could not be better spent elsewhere — if, that is, it is to be spent at all."[35]

On November 19, 1958, the protagonists met the Prime Minister to thrash out a decision. The Chancellor found himself in a minority; more money would be made available but the government's contribution to the project would be capped at £4·5m.[36]

Early in 1959 BEA "suddenly thrust a spoke into the wheel", stating that it now only wanted the

TAH ARCHIVE

ABOVE ***The sole Rotodyne prototype, designated as the "Type Y" by Fairey (the production version was to be the "Type Z") made an appearance at every annual SBAC show at Farnborough during 1958–61, and is seen here peeling away from the camera aircraft during a photographic flight over the Hampshire countryside in 1959.***

Tyne-engined version. This would cost another £2m to develop and the MoS could not see how to pay for it. The Treasury accepted that this was a "jam" and reaffirmed its belief that the aircraft had a poor commercial outlook. Fairey responded positively and was willing "to scrape round and find one-half of the extra sum of £2m required".[37]

Prospects of military interest in the Rotodyne had improved somewhat with the re-emergence of a requirement for a large tactical helicopter. The Army was interested in the Eland-powered version and the Air Ministry estimated that it might have a requirement for 33 aircraft. Buying the civil/military Rotodyne would mean an end to Westland's alternative Westminster bid, which would have attracted substantial American aid for purely military projects. It would also imply sacrificing a number of other transport aircraft to balance the books. This was the rub; the Army had no money to buy the Rotodyne and the RAF and the Air Ministry were financially heavily committed elsewhere.

The Treasury remained sceptical about this renewed military interest. As one Treasury official noted, "Generally speaking, my impression was that the Services' interest, where it existed, was the result of a certain amount of lobbying rather than any deliberate reconsideration of need. It would be difficult not to feel a certain amount of cynicism about a military requirement appearing at so late a stage, the aircraft having already been allowed once to disappear from the defence R&D programme. There are powerful reasons why the Chancellor should strongly oppose an immediate decision to order the military Rotodyne".[38]

In June 1959 the Air Staff agreed that the Rotodyne, although the more expensive option, appeared to be the best answer to the Army's heavylift requirement. If procured alongside the BEA orders, it might also be possible to negotiate a fixed price for the military version. The Defence Board duly approved an initial military requirement for 12 Rotodynes the same month.[39]

That July, at a final ministerial meeting before the October General Election, chaired by the Prime Minister, it was agreed that the government would meet half of the cost of a Tyne-engined version. Fairey agreed to these terms subject to a BEA order.[40]

THE FINAL ACT

The last quarter of 1959 saw the establishment of a brand new Ministry of Aviation (MoA), with Duncan Sandys as its first minister. Sandys brought a new urgency and activism to the process of industrial rationalisation announced in 1958. By the end of 1960 the aircraft industry had been consolidated into two main airframe groups (Hawker Siddeley and BAC), two engine companies (Rolls-Royce and Bristol-Siddeley) and a single helicopter group led by Westland. The latter had already embarked on

PHILIP JARRETT COLLECTION

ABOVE ***With the takeover of Fairey by Westland in early 1960, the Rotodyne's markings were changed to reflect the transfer of the project to the new company, and RAF roundels and fin-flashes were applied to signify military interest. For more on the latter aspect see Chris Gibson's*** **The Air Staff and The Helicopter (*Blue Envoy Press*).**

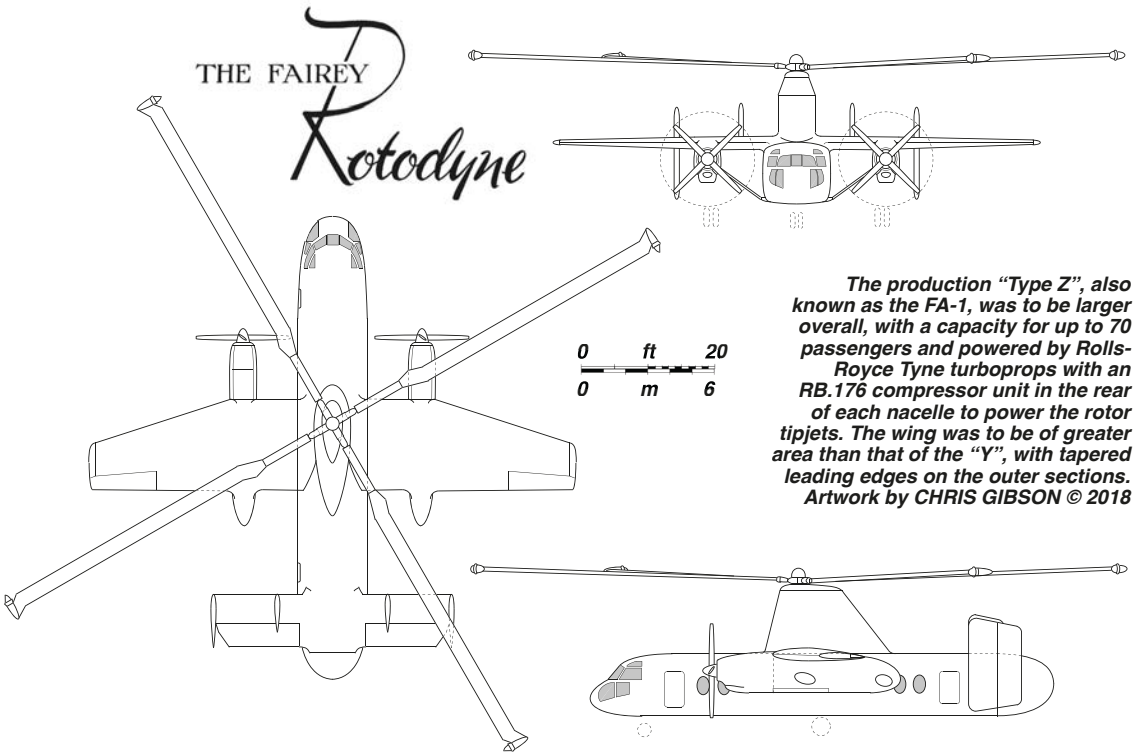
an aggressive acquisitions campaign, taking over Fairey in February 1960. This had been inevitable since Westland's purchase of Saunders-Roe in July 1959, leaving it significant helicopter and hovercraft production contracts and in a healthy financial position. With the cancellation of an ultra-light helicopter contract with the Royal Navy, Fairey became wholly dependent on the Rotodyne. Increasingly unable to sustain the programme (some £70,000 a month) without a further government development contract, Fairey had nowhere else to go.[41]

This left the Rotodyne in limbo, and its future quickly became entangled in the politics of rationalisation. Westland was told that the government attached great importance to the Rotodyne project continuing, in accordance with the terms of the July 1959 arrangements. The MoS was keen to secure the contract for the Tyne version to prevent Westland from "demanding a higher price as a condition of proceeding with the Rotodyne". Although there was nothing to prevent the Fairey-Westland merger going ahead without government approval, it was essential to avoid a position in which the newly-merged company might use the government's agreement with Hawker Siddeley and BAC to fund projects launched before 1960 to press for more support for the Rotodyne. The latter had to be considered on its merits and not as a "special measure to launch this group".[42]

Progress was still dependent on securing a BEA contract and firming up the military requirement. Early in 1960 Westland opened negotiations with BEA, in respect of a civil order, initially for six aircraft. Critically, the government had acceded to a BEA demand, expressed repeatedly over the final six months of 1959, for financial aid in "proving" the aircraft in service. The MoS had wanted a five-year introductory period during which BEA's losses would have been covered, up to a maximum of £1·4m.[43]

There was also "still a good deal of uncertainty in the Service departments as to the extent of the requirement". The price for 12 aircraft had risen from £700,000 to more than £1m and BEA wanted assurances that if it could not operate into cities because of noise-related issues, the military would take over its six. Sandys wrote to Watkinson, by this time Minister of Defence: "Sholto [Lord] Douglas has asked me for an undertaking that the government will relieve BEA of its six orders if the noise issue is unresolved". In a sly reference to Watkinson's time at the MoTCA, he added, "Sholto claims to have received assurance from you when at MoTCA that the risk would not fall on BEA, as it is very unlikely that the manufacturers will be prepared to guarantee that they can keep the noise level to within acceptable limits when these cannot at present be determined".

A possible solution was to divert these orders to the RAF, with which noise would not be so much



The production "Type Z", also known as the FA-1, was to be larger overall, with a capacity for up to 70 passengers and powered by Rolls-Royce Tyne turboprops with an RB.176 compressor unit in the rear of each nacelle to power the rotor tipjets. The wing was to be of greater area than that of the "Y", with tapered leading edges on the outer sections. Artwork by CHRIS GIBSON © 2018

of an issue. The MoD response was terse, and to the effect that exact requirements were still to be assessed and the budget may not allow for another six Rotodynes in the short term.[44] The Treasury wanted assurance that there was a genuine military requirement; "To buy unwanted aircraft is an expensive way of getting development work done". Matters were complicated by "Westland's lack of enthusiasm for the project", the Treasury informing the MoA that "all quotations for the Rotodyne are now withdrawn".[45]

BIG NOISE, SMALL BUDGET

This impasse led to one Treasury official admitting that the "rationalisation of the aircraft industry [is] complicating [the negotiation of] government contracts. One result, where value for money is concerned, is that we are being asked to agree to the purchase of 12 'military Rotodynes' without any accurate idea of all-up cost or satisfactory evidence of aircraft performance".[46]

Noise was still a critical issue; Minister of Defence Watkinson, echoing his former position at MoTCA, said that he could only agree with Douglas that BEA could not bear the "unusual risk" of noise excluding operations from city centres, and that it would be "sensible" to give the assurance that BEA's order would in that event be taken over by the RAF.[47]

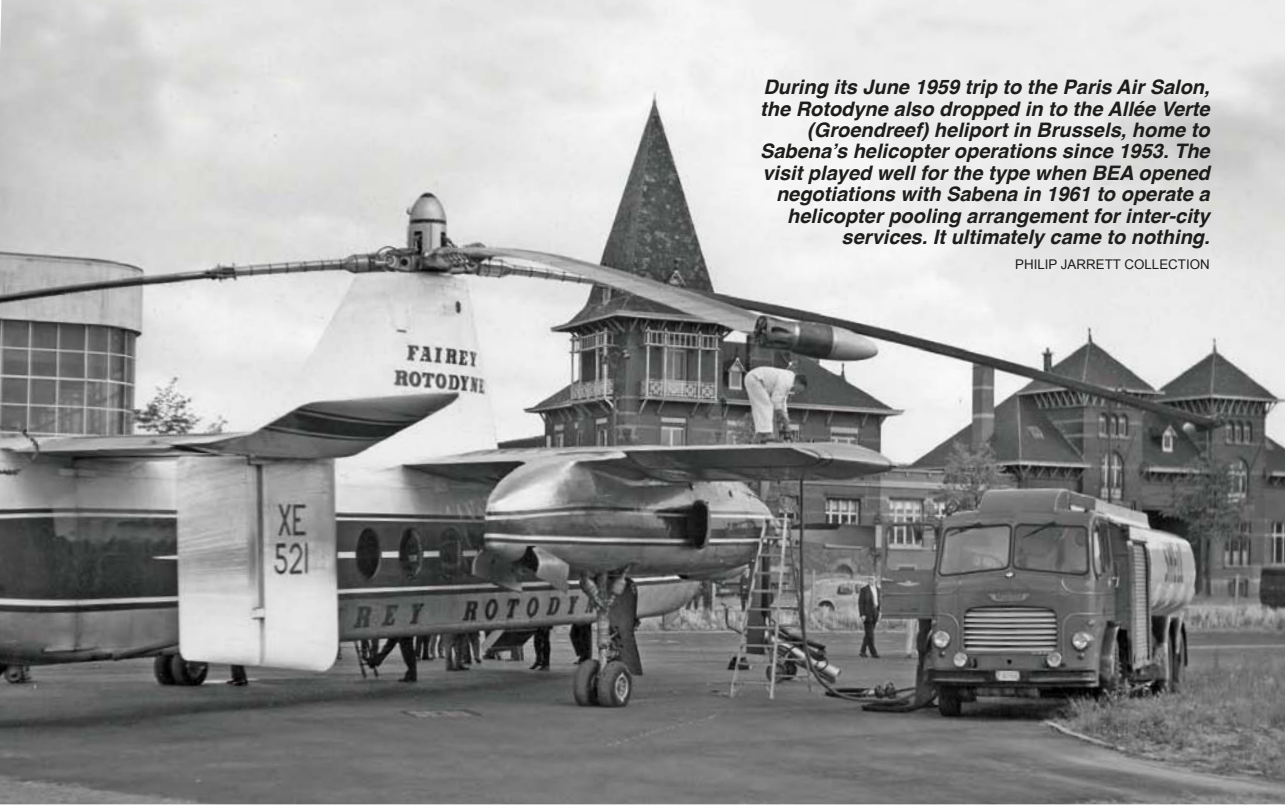
The MoD was beginning to waver and hedge its bets, as a December 1961 MoD note reveals:

"The Minister expressed the view that apart from the strength of the case on military grounds, we have a moral obligation to support the project. The forthcoming Defence Review may or may not increase [the] strength of the case, but all will depend on the budget available, and we cannot at this stage say that the Rotodyne is one of those things that we should wish to retain at any cost".[48]

In February 1961 Westland chairman Sir Eric Mensforth wrote to the Minister of Aviation, by this time Peter Thorneycroft, stating that the risk of a noise ban on the civil Rotodyne meant that his company did "not feel justified in risking any more of [its] money on the present basis of 12 military and six civil orders". However, Westland believed that the Rotodyne was still a potential winner, and proposed converting the current contract into a pure military R&D contract, with a 50/50-funded civil development for 50 aircraft, to take advantage of the civil launch-aid policy announced in January 1960.

The Treasury saw this as a ploy to make "HMG [Her Majesty's Government] pay" for the civil version. Officials believed the Air Ministry would reject the proposal but that the MoA would be in favour, a Treasury note from February 1961 stating that "the MoA is likely to argue that the Rotodyne must go on in order to keep a helicopter firm in business. Mr Sandys' policy statement of February 1960 spoke of a helicopter firm as part of the permanent furniture of the industry". This was heading into troubled waters, but "when battle begins, I should expect the Air Ministry and MoD to do most of our work for us. But we shall need to make sure that they do."[49]

By March 1961 the MoA had effectively fused the civil and military strands of the programme.



During its June 1959 trip to the Paris Air Salon, the Rotodyne also dropped in to the Allée Verte (Groendreef) heliport in Brussels, home to Sabena's helicopter operations since 1953. The visit played well for the type when BEA opened negotiations with Sabena in 1961 to operate a helicopter pooling arrangement for inter-city services. It ultimately came to nothing.

PHILIP JARRETT COLLECTION

Preliminary noise trials seemed to be within acceptable limits but Thorneycroft accepted that a BEA request for indemnity was reasonable.[50] Westland had now reviewed the project with "a good many misgivings", but both it and BEA were happy to continue, subject to agreement on an indemnity. However, the Treasury was increasingly concerned that the total cost of the project would fall under the civil aircraft programme, which was now approaching £30m.[51]

AN AVENUE OPENS . . .

In June 1961 another avenue appeared to open; BEA was negotiating an agreement with Sabena to launch European inter-city helicopter services. Initially, the UK side would have to use American helicopters, but the Rotodyne would appear to be ideal for subsequent services (assuming that the noise problem was resolved and adequate infrastructure investment was authorised by the Treasury — a far from done deal).

According to Thorneycroft, this was an opportunity to educate Europeans into the value of civil helicopters in general and the Rotodyne in particular. There was also an opportunity to further support Britain's application to join the European Economic Community. There was just the small matter of BEA's request for a £500,000 subsidy to launch the service.[52]

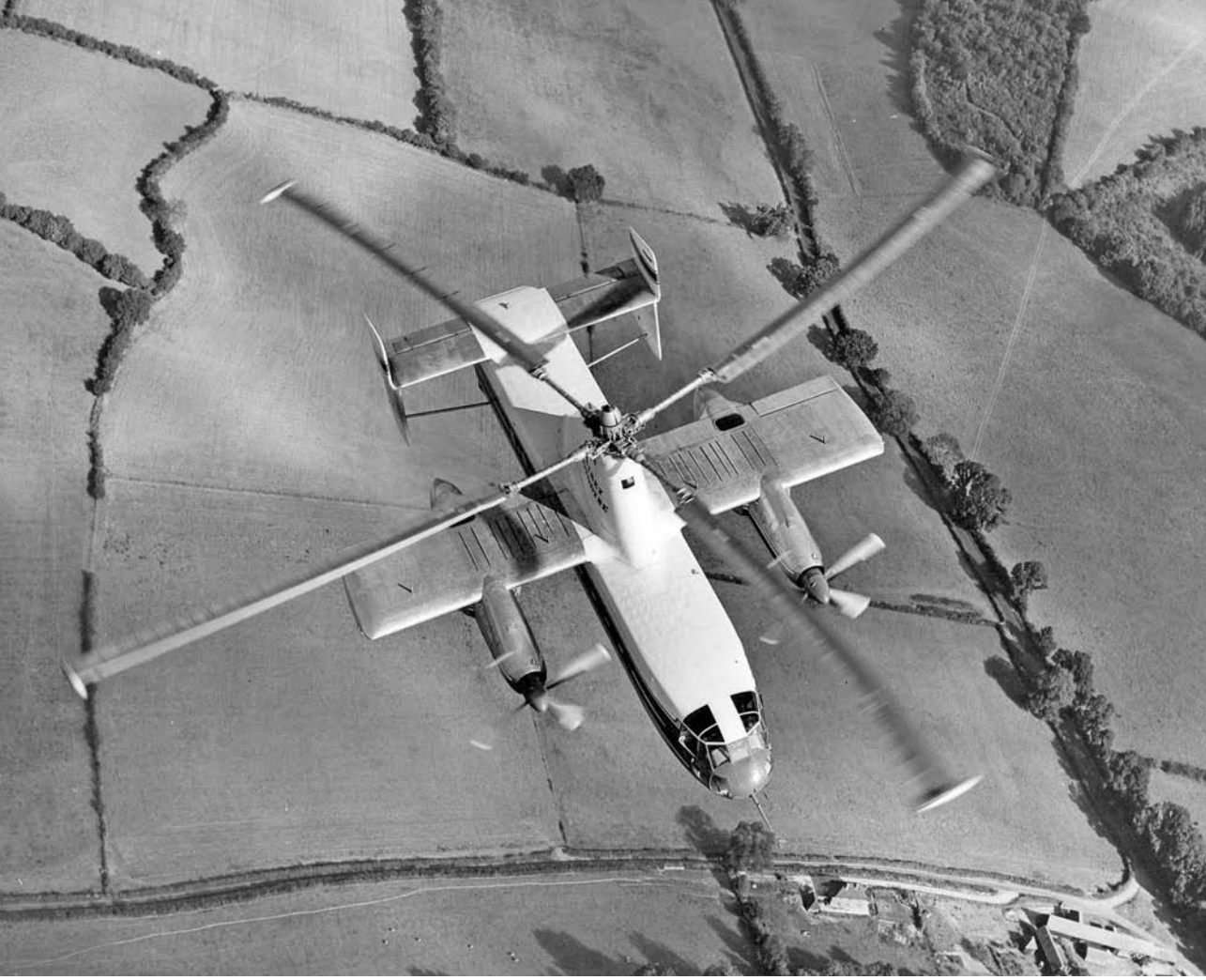
Thorneycroft's appeal got short shrift from Treasury officials. The connection between BEA's helicopter service plans and the Rotodyne "is remote and indirect, and who can seriously argue that to help develop and ultimately sell Rotodynes some time in the future, we ought to subsidise a service using American helicopters now?"

The Treasury also felt that MoA officials were rather embarrassed by the proposal. Referring to a meeting with one, a Treasury official wrote: "He faithfully argued the Minister's case. But I have the impression that, left to himself, he would not look at it for a moment". However, he went on, the Minister "feels passionately and is making a great issue of it". Wider European issues were deemed irrelevant and not to be used as an excuse to increase government expenditure. The motive appeared to be the need "to provide further, but indirect, assistance to the UK helicopter manufacturer, with [the] Rotodyne mainly in mind". The proposal was duly rejected.[53]

By late 1961 military interest in the Rotodyne was on the wane. The MoD thought it possible that almost all of the tactical transport requirement could be met with a mixed force of aircraft and Bristol Belvedere helicopters: "The passage of time has tended to see [the military requirement] weaken and the current review may weaken it still further". There was "a military case for buying the Rotodyne. But I don't know if we can afford it. If they are purchased for military use, the governing consideration will almost certainly be the needs of the aircraft industry".[54]

. . . AND CLOSES

In February 1962 an agreement was finally concluded with BEA. The government would contribute up to £1·4m towards the costs of introducing the Rotodyne into service.[55]



PHILIP JARRETT COLLECTION

ABOVE ***In January 1959 the Rotodyne set a new helicopter world speed record over a 100km (62-mile) closed circuit of 191 m.p.h. (307km/h). The Rotodyne was fast, with a great deal of potential for development — but neither industry nor government was prepared to risk so much on such a new commercial and military concept.***

It was too late. In their 1962 Defence Review, the Chiefs of Staff "reluctantly" judged that the Rotodyne's priority was insufficiently high to justify its inclusion in their plans for British strategy in the 1960s.[56] Thorneycroft made a final appeal before the Cabinet met to decide the project's fate. Cancellation of the Rotodyne would lose the military a heavylift VTOL capability that would not become available until the advent of the Boeing Vertol Chinook in the 1980s, and the civil version was "so unique of its kind that it might achieve a breakthrough in civil markets".

Thorneycroft also observed that "complaints would be made that the government was failing to carry out its declared policy of supporting the civil industry, and that little purpose had been served in encouraging the formation of a helicopter group when its main forward-looking project was to be abandoned". The project was terminated by a Cabinet decision on February 12, 1962, justified solely on financial grounds and not because of operational or technical failings.[57]

So ended the Rotodyne. So often the public symbol of Britain's aeronautical prowess and a star performer at several Farnboroughs, it never quite convinced as either a civil or military concept. The vision of inter-city VTOL services effectively died because of an inability to solve the type's inescapable noise issues and a lack of enthusiasm for infrastructure investment.

The military requirement waxed and waned without really overcoming the reluctance on the part of the RAF and Air Ministry to divert resources from conventional aircraft to a novel solution to the Army's tactical transport requirements. It was certainly an advanced project consistent with the government's policy towards aeronautical research expressed in the late 1950s, but the Rotodyne ultimately lacked the "end-user" endorsement and industry commitment that would justify heavy public investment — a factor which helped to give the contemporary SST proposal its political support and taking it through to a well-funded launch.

ENDNOTE REFERENCES

1 Treasury official, March 4, 1960; The National Archives (TNA) ref T225/1609
2 See Uttley, Matthew, *Westland and the British Helicopter Industry 1945–60*, Routledge, 2013. A fine archive-based study of helicopter policy during the 1940s and 1950s
3 For a full technical history of the Rotodyne see Taylor, H.A., *Fairey Aircraft since 1915*, Putnam, 1974
4 *The Helicopter and its Potential*, AVIA 65/6, February 6, 1953; Uttley, op cit, p122
5 MoS memo to Treasury, April 20, 1954, T225/1607; Transport Aircraft Requirements Committee (TARC) minutes, March 19, 1954, AVIA 63/4: Uttley, op cit, pp132–137
6 Ibid; also letter from MoTCA to Minister of Supply, AVIA 65/6, January 11, 1954
7 Exchange of correspondence in T 225/1607
8 Letter from Lord Douglas to Minister of Transport, July 11, 1956, T 225/1607
9 Minister of Supply letter to Minister of Transport & Civil Aviation, July 13, 1956, and Minister of Transport reply, July 25, 1956, T 225/1607
10 Treasury note, August 9, 1956, T 225/1607
11 Treasury note, July 27, 1956; letter from Chancellor of the Exchequer (CoE) to MoTCA Minister, July 31, 1956, T 225/1607
12 Ibid
13 Treasury memo, November 26, 1956, T 225/1607
14 Hayward, Prof Keith, *Kill or Cure? The View from Whitehall*, *The Aviation Historian No 19*, April 2017
15 Treasury memo, September 23, 1957, T 225/1607
16 Minutes of TARC meeting, February 21, 1958
17 Letter to Minister of Transport from Lord Douglas of Kirtleside, May 1958, T 225/1607
18 MoS letter to Treasury, December 20, 1957, and Treasury memo, January 1, 1958, T 225/1607; Treasury memo September 23, 1957, T 225/1607
19 Treasury memo, February 4, 1958, T 225/1607; Letter from Minister of Supply, January 31, 1958, T 225/1607
20 Treasury note, *Development of the Rotodyne Helicopter*, June 3, 1958, T 225/1607
21 Personal Minute to Minister of Supply, June 4, 1958, PREM 11/3640
22 Minister of Supply note to Prime Minister (PM), September 30 1958, PREM 11/3640
23 Ibid
24 Minister of Transport memo to PM, October 3, 1958, PREM 11/3640
25 Minister of Supply note to PM, November 10, 1958, PREM 11/3640
26 Minister of Supply note to CoE, September 30, 1958, T225/1608
27 Minister of Transport to PM, October 3, 1958, T225/1608
28 Treasury memo, October 3, 1958, T225/1608. The discrepancy in MoS estimates was due to the inclusion of all the Napier Eland costs on the Rotodyne account. Total expenditure to this point was £11·7m
29 Minutes of Treasury meeting, October 17, 1958, T225/1608
30 Report of internal Treasury report, October 29, 1958, T225/1608
31 Note from PM's Office to Treasury, November 11, 1958, PREM 11/3640
32 Minister of Defence memo, November 12, 1958, PREM 11/3640
33 Memo from Minister of Supply to PM, November 14, 1958, PREM 11/3640
34 Memo from MoTCA Minister to PM, November 17, 1958, PREM 11/3640; Treasury memo, November 18, 1958, T225/1608
35 Treasury memo, November 18, 1958, T225/1608
36 Memoranda to MoS from MoTCA, December 2, 1958, and note from MoS to PM, December 19, 1958, PREM 11/3640
37 Ministry of Defence (MoD) note to Treasury, February 26, 1959; Treasury notes, January 30, February 2 and March 12, 1959, T225/1608
38 Treasury notes, February 19 and 26, May 8, July 7, 8 and 9, 1959, T225/1608
39 Minutes of Minister of Defence, June 25,1959 — comparison of Rotodyne and Westminster proposals, DEFE 7/1335
40 Ministerial meeting chaired by PM, July 9, 1959, PREM 11/3640
41 Uttley, op cit. pp183–187
42 Minutes of MoS discussion with the Treasury, January 20, 1960, T225/1608
43 Ibid
44 Letter to Minister of Defence Harold Watkinson from Duncan Sandys, Minister of Aviation, June 7, 1960; MoD response, November 22, 1960, DEFE 7/1335
45 Treasury note, February 16, 1960, T225/160
46 Treasury note, March 4, 1960; Treasury letter to Air Ministry, March 16, 1960, T225/1609
47 Note from Minister of Defence Harold Watkinson, June 7, 1960, T225/1827
48 MoD note, December 1, 1961, DEFE 7/1335
49 Treasury note, February 7, 1961, T225/1827
50 Letter from Ministry of Aviation (MoA) to Chancellor, March 30, 1961, T225/1827
51 Treasury note, April 5, 1961; Minister of Aviation to Treasury, April 13, 1961,T225/1827
52 Minister of Aviation Peter Thorneycroft letter to CoE, June 27, 1961, T225/1827
53 Treasury note, July 14, 1961, T225/1827
54 Brief for Minister of Defence on "Future of Aircraft Industry", October 16, 1961, and Minister of Defence Memorandum "Light Cargo Aircraft", December 7, 1961, DEFE 7/1335
55 "Future of the Rotodyne" memorandum by Minister of Aviation, February 9, 1962, CAB 129/108
56 Brief to Minister of Defence, February 12, 1962, DEFE 7/1336
57 Ibid; also memo from Minister of Aviation to Cabinet Defence Committee, February 16, 1962; Minister of Aviation note to PM, February 12, 1962, CAB 129/108

Jaguar INTERNATIONAL in Nigeria

In 1983 Nigeria signed a contract for 18 Jaguar International export variants of the sleek Anglo-French ground-attack jet fighter. **ARNAUD DELALANDE** chronicles the type's Nigerian Air Force career, which can only be described as inaction-packed — with a lack of spares, skills and equipment, the Jaguars spent little time in the air before being grounded

The first Nigerian Air Force Jaguar International single-seat SN variant, serial NAF705, on a test flight from BAe Warton in January 1984, the month after it had made its first flight. It was delivered to Nigeria in August 1984, but, like its NAF companions, flew very little until it was grounded permanently at Makurdi in 2014. TAH ARCHIVE

IN 1961 NIGERIA'S engagement in peace-keeping missions in the Republic of the Congo (aka Congo-Léopoldville) and Tanganyika, in which foreign air arms had to be used to transport Nigerian troops to these theatres of war, prompted the nation's impetus to strengthen its military position in Africa — and thus was a major influence in the establishment of the Nigerian Air Force (NAF) in April 1964.

The fledgling air arm initially operated one Nord Noratlas and one Douglas DC-3 until West Germany's Luftwaffe Technical Assistance Group (TAG) provided two Dornier Do 27 single-engined STOL aircraft, two Mercedes-Benz cars and one Land Rover.

After the Biafran War of 1967–70 (aka Nigerian Civil War), the Nigerian federal government began equipping the NAF with various weapons and aircraft systems and also obtained technical assistance from the industrialised supplier nations, which provided permanent personnel to work alongside trained NAF technicians to ensure adequate support for these systems.

The activities of the NAF reached a peak during 1975–87, but began to decline thereafter, resulting in the precarious conditions prevailing today. As of 2004, more than 95 per cent of all NAF aircraft and weapons systems have been immobilised owing to severely reduced technical support. Of a total of 166 aircraft in the NAF, some 149 are reported to have been abandoned and/or are in poor storage conditions.

In the 1980s the NAF initiated the Aeronautical & Industrial Engineering Project (AIEP), as part of which an indigenous lightweight aircraft — the ABT-18 Air Beetle (essentially a licence-built Vans RV-6A kit aircraft) — was developed for training duties. During this period the NAF's technical ability was good, and 60 ABT-18s were produced locally. Had it continued, this manufacturing programme would no doubt have made a a substantial contribution to Nigeria's national development. However, the technical capacity of the NAF decreased and no more ABT-18s were built.

Mixing and matching

Nigeria's acquisition of aircraft by its government was based more on acquiring prestige by association and displaying wealth, and thus tended to focus more on the status of the suppliers than the air arm's actual requirements. Ultimately this was what led to the NAF's acquisition of Soviet-built MiG-21s and European Sepecat Jaguar International military jet aircraft. In the mid-1980s Nigeria also acquired 25 Czech-designed Aero Vodochody L-39ZA ground-attack aircraft, of which fewer than a dozen remain airworthy in 2018.

During its 44-year existence, the NAF has operated some 29 different types of aircraft and weapons systems acquired from nine different countries. Maintaining these platforms

OPPOSITE PAGE ***The increasingly forlorn collection of NAF Jaguars, with flat tyres and faded paint, undergo a rare inspection at Makurdi in May 2015. Bizarrely, the Jaguars made an appearance in 2017 on UK television show*** **Posh Pawn,** ***in which the grounded fighters were offered for sale; sensibly, the pawnbroker declined!*** CLAUDE BERTINI

VIA AUTHOR

ABOVE ***Another view of the first of the NAF's single-seat Jaguars, NAF705, during a test flight in the UK. Following border clashes with Chad, Nigeria underwent a bloodless coup on December 31, 1983, although the deliveries of the Jaguars to Nigeria continued under the new leadership of Maj-Gen Buhari, all having been delivered by 1985.***

TAH ARCHIVE

ABOVE ***Nigerian Jaguars under construction at BAe Warton in the spring of 1984. The nearest airframe, still in primer, became NAF709 and made its first flight on May 11 that year, before being delivered to Nigeria that September. A total of 18 Jaguars was acquired by the NAF, with an option for 18 more, which was never taken up.***

VIA AUTHOR

ABOVE ***Two-seat Jaguar BN serial NAF703 made its first flight on March 1, 1984, and was delivered to Nigeria that August. The trainer version sported a second cockpit, also fitted with a Martin-Baker 9B Mk II zero/zero ejection seat, which was raised 15in (38cm) higher than that of the front cockpit. Both cockpit canopies were bulletproof.***

has caused severe headaches for the NAF, particularly with regard to technical and engineering issues, owing to a complete lack of standardisation and interoperability.

The choice of Jaguar

A major redevelopment of Nigeria's defence capabilities was included in the 4th National Development Plan for the Armed Forces, which detailed the country's present and future military requirements up until 1985. New fighter aircraft were sought to complete the NAF's sole squadron, in the mid-1980s equipped with 20 MiG-21MFs. Considerable interest was shown in the export version of the Anglo-French Jaguar ground-attack jet aircaft designed and built by the *Société Européenne de Production de l'Avion d'École de Combat et d'Appui Tactique* (Sepecat), designated Jaguar International.

A memorandum of understanding regarding the acquisition of Jaguars, support material and the training of personnel, worth more than £200m, was signed with the British part of the Sepecat consortium, British Aerospace (BAe), in 1982. Having previously acquired a batch of 12 German-built Dassault-Breguet/Dornier Alpha Jets, with an option for 12 more, it was thought that the Nigerians would continue to negotiate with the Germans for more Alpha Jets, but in June 1983 the Nigerian Jaguar order was officially placed for 18 aircraft (plus 18 options, later cancelled), comprising 13 single-seat Jaguar International SN variants and five two-seat BNs. Deliveries to the 64th Air Defence Group at Makurdi in central Nigeria began early the following year. Despite the instability caused by the military coup led by Muhammadu Buhari in late December 1983, Jaguar deliveries continued until 1985.

The Nigerian Jaguars were fitted with British-spec laser-ranging and marked-target seeker (LRMTS) equipment in the nose, overwing pylons fitted with rails to carry AIM-9 Sidewinder air-to-air missiles and a 5,520lb-thrust (8,400lb-thrust with afterburning) Rolls-Royce Turboméca Adour Mk 811-58 engine.

Two Jaguars were lost in accidents during the type's short career with the NAF; a single-seat SN crashed in 1984, killing Flt Lt Shaman Musa, as did another single-seater in 1990, killing Sqn Ldr Garba in what was to be one of the type's last flights in Nigerian service.

The Jaguar has the dubious distinction of being the NAF's shortest-serving aircraft, largely owing to the nature of the purchase contract for the type and international arms-transfer policies of the time. The NAF was also denied the purchase of advanced weapons to improve its deep-strike capabilities, as well as the acquisition of a tanker aircraft. Stipulations were made that these aircraft were to be used only for defensive purposes and that the NAF risked a withdrawal of technical support and spare parts should they be used otherwise. At the same time, the NAF

CLAUDE BERTINI

ABOVE ***During 2014–15 the late Claude Bertini, a former* Armée de l'Air *technician, was contracted as part of a team to refurbish the NAF's Alpha Jet force. While at Makurdi, Bertini took the opportunity to photograph what was left of the Jaguars, including this single-seater which had been placed on jacks and tyres on a trolley.***

was also fobidden to resell or transfer its fighter-bombers to a third party without the approval of BAe and the UK's Ministry of Defence.

Premature retirement

Nigeria's technical support agreement for the Jaguar ultimately expired and was not renewed, by which time the UK Jaguar assembly line at BAe Warton had closed. Thus the only option regarding maintenance and spares was India, where Hindustan Aeronautics Ltd (HAL) at Bangalore had built the type under licence for the Indian Air Force.

When the Nigerian Jaguars were officially retired in 1991, most had recorded less than 150hr flying time. The most-used was Jaguar NB serial NAF703, which had 150hr 54min on the clock when it was withdrawn; amazingly, it had only 100hr when inspected five years previously on February 10, 1986. The Nigerian Jaguar force could therefore be considered virtually brand new when the type was retired. Nevertheless, the aircraft were parked and abandoned at Makurdi air base.

An attempted resale failed following their inspection and evaluation by BAe, which was considering buying the aircraft back at a price well below that which Nigeria had paid for

Still on its own undercarriage but looking somewhat the worse for wear, two-seater BN serial NAF702, delivered in October 1984, sits alongside an NAF MiG-21 at Makurdi three decades later. The BNs did not have the rectangular fin-mounted electronic countermeasures housing fitted to the SNs.

CLAUDE BERTINI

CLAUDE BERTINI

ABOVE ***Jaguar BN serial NAF703 has its covers pulled for an inspection at Makurdi. In 2012, at least one of the single-seaters was put on popular online auction site eBay by an American source, with a starting bid of $900,000 and valued at $2·7m. Unsurprisingly there were no bids and the aircraft remain deterioriating at Makurdi in 2018.***

them. In 2004 the NAF planned to reactivate its immobilised MiG-21 force, but the cost of the overhaul and upgrade programme proposed by Israeli company ELTO could not be justified for a fleet of outdated aircraft that had been stored for more than 16 years.

During 2009–10 the NAF received 12 examples of the Chengdu F-7, a Chinese licence-built version of the MiG-21, comprising a mixture of F-7NI single-seaters and FT-7NI two-seaters. In 2018 around half of these are operational, alongside eight Alpha Jets. On June 20, 2012, the NAF put a large batch of military aircraft up for sale, including 25 MiG-21Bis/MF/UMs and 16 Jaguars at Makurdi, three Lockheed C-130s at Lagos, a Fokker F.27 turboprop transport at Benin City in southern Nigeria, three Messerschmitt-Bölkow-Blohm (Eurocopter) Bo 105 helicopters at Port Harcourt, nine Mil Mi-34 light helicopters at Enugu and 13 Scottish Aviation Bulldogs at Kudana.

In 2014 China supplied at least five CASC CH-3B fixed-wing unmanned combat air vehicles (UCAVs) which could be equipped with YC-200 guided bombs and AR-1 air-to-surface missiles. The late Claude Bertini, a former *Armée de l'Air* mechanic engaged on an assistance mission to Nigeria for the rehabilitation of the NAF Alpha Jets in 2014, later recalled that there was talk of refurbishing the Jaguars. An overhaul and restoration programme was established, but, by the time Bertini had concluded his mission in 2015, no further progress had been made and the Jaguars appear to remain in poor condition in storage at Makurdi.

ACKNOWLEDGMENTS *The author would like to thank the late Claude Bertini for his invaluable assistance with the preparation of this article*

Nigerian Air Force Jaguars

Serial	Type	Delivery date	First flight	B Cond serial †
NAF700*	BN	18.09.84	13.10.83	G-27-387
NAF701	BN	25.09.84	02.11.83	G-27-388
NAF702*	BN	30.10.84	22.11.83	G-27-389
NAF703*	BN	20.08.84	01.03.84	G-27-390
NAF704	BN	11.12.84	18.04.84	G-27-391
NAF705*	SN	20.08.84	21.12.83	G-27-392
NAF706	SN	28.08.84	10.01.84	G-27-393
NAF707	SN	28.08.84	03.02.84	G-27-394
NAF708*	SN	18.09.84	28.03.84	G-27-395
NAF709*	SN	25.09.84	11.05.84	G-27-396
NAF710*	SN	30.10.84	18.06.84	G-27-397
NAF711*	SN	11.12.84	18.07.84	G-27-398
NAF712*	SN	10.04.85	07.08.84	G-27-399
NAF713	SN	10.04.85	01.11.84	G-27-400
NAF714	SN	04.06.85	14.12.84	G-27-401
NAF715	SN	04.06.85	12.03.85	G-27-402
NAF716*	SN	25.06.85	11.03.85	G-27-403
NAF717*	SN	25.06.85	01.05.85	G-27-404

† B Conditions marking as flown in the UK
* Noted as still stored at Makurdi in 2014

FLYING HOME FOR THE SHEEP-SHEARING

ERNLE CLARK'S 1936 SOLO FLIGHT FROM THE UK TO NEW ZEALAND

In October 1936 New Zealand farmer and part-time flyer Ernle Clark acquired a handsome red-and-silver Percival Gull while on an extended holiday in the UK. Despite his extremely limited flying experience, he decided to fly it the 14,000 miles home. **ERROL MARTYN** uses Clark's own recollections of the epic flight to bring his remarkable achievement to light

OF THE MANY long-distance direct flights made from the UK to Australia during 1919–35, only one aeroplane and crew continued directly on across the Tasman Sea to New Zealand, albeit with a ten-day stopover in Australia. This was 1934 MacRobertson Air Race competitor de Havilland D.H.89 Dragon Rapide ZK-ACO *Tainui*, crewed by New Zealanders Jim Hewett, Cyrus Kay and Frank Stewart. There was one other aeroplane that flew from England to New Zealand during the period — Avro Avian G-ABCF, *Southern Cross Junior* — but its flight over the distance was by coincidence, rather than by design, and by two different pilot-owners over a three-month period. Charles Kingsford Smith flew the Avian solo from London to Sydney during October 1930, after which he sold it to Guy Menzies, who then flew it solo across the Tasman from Sydney to Hari Hari on January 7, 1931. However, between October 6 and November 15, 1936, a period of less than six weeks, two flights all the way from the UK to New Zealand would be completed. Both were flown solo and in Percival Gull monoplanes, with both of their pilots setting out from Lympne airfield in Kent. The final destination for one was New Zealand's North Island and the other South Island. It seems likely that neither pilot was aware of the other's intention at the time. The first to depart was the well-known aviatrix from New Zealand, Jean Batten, who had already accumulated several years of experience in long-distance and record-setting flying. Pushing

Seemingly undaunted by the colossal journey ahead, Ernle Clark poses on the wing of his Percival Gull Four, ZK-AES, before his departure from Lympne airfield for Italy on October 26, 1936. At this point Clark had flown less than 10hr in the aircraft.

ALL PHOTOGRAPHS VIA THE CLARK FAMILY UNLESS OTHERWISE STATED

herself to the limit with minimal sleep along the way, Batten had relatively little difficulty in setting a new England—Australia record while en route to New Zealand in her 200 h.p. Percival Gull Six, G-ADPR. She touched down at Mangere on the North Island on October 16, 1936. Her time, for this first truly direct flight, was 11 days 45min — a record that stood for the next 44 years.

As Batten took off from Lympne, Ernle (pronounced "Ernlee") Clark, who may earlier have had thoughts of being the first solo pilot to complete the journey, was still a day away from making only his third flight in his less powerful Percival Gull Four. So although he had no chance of setting any new records — not only was Batten's machine faster, she, unlike Ernle, planned to fly through the night as well as by day — a successful flight on his part could at least make him the first male pilot to complete a solo UK—New Zealand flight.

FROM FARMER TO FLYER

Born in Christchurch on New Zealand's South Island on August 16, 1906, Leonard Ernle Clark — commonly known by his second name to distinguish him from his father — was the son of estate agent Leonard Ernest and Mabel Elton Clark (née Sanders). He entered Wanganui Collegiate School in 1921, becoming a prefect there before sailing for the UK in 1924 to study at Oxford University's Magdalen College, for which he crewed as stroke for one of its rowing teams. Around 1932, some years after his return to New Zealand, he began sheep farming, mainly with Corriedales, on his 1,500 acres at Iffley, near Waikari.

A few years later he became interested in flying, and in June 1934 began lessons under Canterbury Aero Club (CAC) instructor Ron Kirkup and later Sam Gibbons. This meant a 60-mile (97km) round trip from Iffley to Wigram as and when farming duties permitted. It was not until the following January that he soloed (at Timaru), but he did so after just 5¼hr of dual instruction, an extremely creditable performance. Four months later he passed the test for his Pilot's "A" Licence (No 806), which was issued to him on June 5, 1935, and followed this by obtaining his Ground Engineer's Licence (No 129) on November 28 the same year.[1]

His flying with the CAC was largely drama-free, but there was a moment of excitement when, in July 1935, he was one of five undergoing instruction in parachute jumping with Bernard Skinner. Their first jumps took place on the 21st, with Ernle, under the direction of Skinner, jumping alone from 2,000ft (600m) at 1030hr from de Havilland Fox Moth ZK-ADH, piloted by Gibbons. Leaving the biplane was the easy part; alighting proved somewhat more challenging. "Just missed the hangars and hit a picket fence", Ernle recorded in his logbook.

ABOVE ***A parachutist drops from the Canterbury Aero Club's de Havilland D.H.60G Moth ZK-AAW (c/n 1197), in which Clark passed his "A" Licence test in June 1935. This photograph was probably taken around the same time that Clark made his jump from Fox Moth ZK-ADH (c/n 4085) the following month.***

On March 7, 1936, having accumulated just over 25 flying hours, Ernle sailed on the New Zealand Shipping Company's *RMS Ruahine* for a holiday in England. Here he would spend time with his younger brother Kyrle, then living in London's Highgate, and with their mother at her home in Fleet, Hampshire. A fortnight after disembarking at London, he joined the recently formed Yapton Aero Club at Ford in Sussex and began flying there on April 29. On Sunday June 7 Ernle scored himself a free breakfast at Reading while undergoing some dual instruction with Flt Lt Jones in a D.H.60 Moth. Taking off from Yapton at 0805hr the pair "flew above clouds to Fleet then down & v. low to Reading". Their "raid", arriving unobserved and catching the Reading club off guard, won them their reward.[2]

During his six-month visit Ernle took the opportunity to gain experience on a variety of de Havilland types, including Gipsy, Cirrus, Hornet, Fox and Puss Moths, as well as other types such as the Miles Hawk, Spartan Three-Seater, Avro Avian, and various Percival Gulls. His sole flight in Spartan Three-Seater G-ABLJ (c/n 59) on July 25 with club flying instructor W.J. Alington was unusual, being for the purpose of "taking photographs of flight refuelling for Sir Alan Cobham", one of Britain's most famous aviation pioneers.

Ernle's logbook entry for his only Hornet Moth flight, on August 10, 1936, records it only as "ZK-", without any following registration letters. The

In July 1936 Ernle Clark purchased Avro Avian IV G-AAHE and operated it from Ford in West Sussex. Clark flew the machine regularly, including trips to the Continent, until his return to New Zealand in October that year. The Avian's C of A expired the following March and it was presumably stored until its acquisition by Horton Kirby Flying Club in Kent in January 1939.
EDDIE J. RIDING VIA RICHARD T. RIDING

passenger is recorded as "Mr Mill", probably a reference to F. Douglas Mill, the New Zealand agent for de Havilland. The aeroplane may have been the sole Hornet Moth later imported into New Zealand, ZK-ACP (formerly G-ADSJ), which was destroyed there in a fatal accident on April 18, 1938. Ernle also undertook some blind-flying instruction, making three such flights "under the hood" — experience that would prove invaluable on his flight to New Zealand.

He enjoyed flying second-hand Avro Avian IV G-AAHE (c/n 319) so much that, following a trial flight on June 26, he purchased it. Basing the biplane at Ford, he flew it regularly until his last flight in it on October 23, including two week-long visits to France and Switzerland.[3] The New Zealander also took the opportunity to bring himself up-to-date with the UK's local farming scene, finding that "there is no doubt that farming in England has made big strides". An inspection of an experimental farm in Grimsby, Lincolnshire, particularly impressed him with the up-to-date methods employed.

ACQUIRING THE GULL

By August 1936 Ernle appears to have been seriously contemplating a more advanced machine, with a more ambitious journey in mind, as on the 7th and 8th he made trial flights in Percival D.2 Gull Four G-ACUL, and two months later purchased the handsome red-and-silver monoplane. He made his first flight in the Gull Four as its new owner on October 7, by which time it seems it was already wearing New Zealand registration markings ZK-AES.

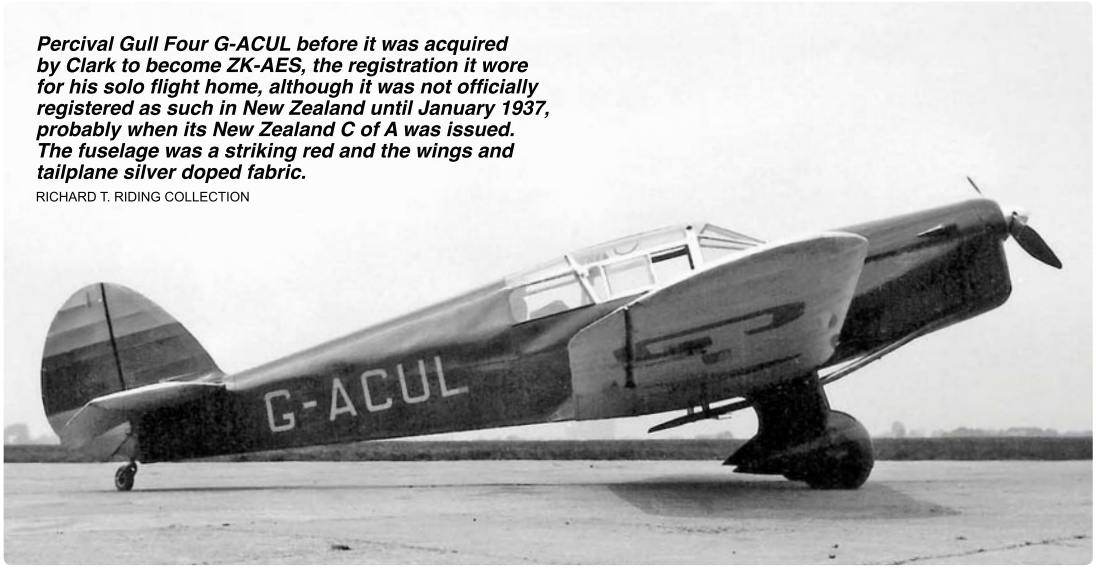
Earlier, he had cabled the Canterbury Aero Club back in New Zealand, suggesting that it purchase a machine and allow him to fly it out to its new home in order to save on the freight.[4] The club, however, favouring caution over using an unproven method of delivery, replied that it preferred to have its aeroplanes sent by sea.[5]

The Gull Four — G-ACUL (c/n D.45) — was the first to be built at Percival's own factory at Gravesend in Kent. It featured a "modified cabin, undercarriage and wing-locking developed for the 1934 model". (The first production batch of 24 Gulls had been built during 1932–33 under contract to Parnall at Yate, near Bristol.) This machine was first sold to Lt Patrick Randolph of the Grenadier Guards; it was his second Gull (his first was from the first batch). According to David W. Gearing's *On the Wings of a Gull* (Air-Britain, 2012), 'CUL had its 130 h.p. de Havilland Gipsy Major engine replaced by a 200 h.p. Gipsy Six in 1935. Either this is incorrect or the aeroplane was reconfigured again with a 130 h.p. Gipsy Major, the engine it came with when Ernle took ownership. Randolph was a competitor in various air races during the 1930s and in June 1936 upgraded to Gipsy Six-powered Percival Vega Gull G-AEKD, presumably trading in his old Gull to Percival as part payment.[6]

Ernle purchased 'CUL direct from the Percival company. According to its Journey Log Book, company owner Edgar Percival performed a 10min test flight in it at Gravesend two days before Clark's first flight in it as the new owner.

FINAL PREPARATIONS

By October 26 Ernle had 141 hours recorded in his logbook, only 9hr of which were in the Gull. His longest single flight in any aeroplane to that point had been one of just 2hr. He had flown a total of 8hr in a single day, however, when returning to the UK from Switzerland on August 23. By any standard it was a limited amount of experience with which to set out on a 14,000-mile (22,500km) solo flight over unfamiliar territory. But Ernle had planned well, installing



Percival Gull Four G-ACUL before it was acquired by Clark to become ZK-AES, the registration it wore for his solo flight home, although it was not officially registered as such in New Zealand until January 1937, probably when its New Zealand C of A was issued. The fuselage was a striking red and the wings and tailplane silver doped fabric.
RICHARD T. RIDING COLLECTION

an additional fuel tank to give him a maximum range of about 2,000 miles (3,200km), and was quietly confident about the undertaking.[7] When he touched down at Blenheim on New Zealand's South Island 20 days later his flying experience had almost doubled, his logbook recording a total of nearly 265hr.

On Saturday October 10 Ernle flew the Gull to Ford to bid farewell to his friends at Yapton Aero Club, the club's notes, appearing in UK weekly magazine *Flight*, recording that he "must hurry home for the sheep-shearing".[8] Ernle flew to Lympne from Gravesend on the 25th.

At dawn the next day, in a bitterly cold wind, Ernle's widowed mother — who, along with the Automobile Association (AA) and map specialists E. Stanford Ltd, had helped him in his planning of the journey — his brother Kyrle, a reporter (who noted with some concern that the pilot was "not wearing a hat or coat") and Lympne's "commander" gathered to wish him good luck and see him off.[9] At 0620hr the Gull Four lifted off from Lympne's grass airfield. Ernle carried no radio or navigation aids apart from a compass and an assembly of strip maps on a home-made roller in a chocolate box.

He had never flown at night, but was soon to be confronted with flying in the dark. Once airborne, the 30-year-old pilot was completely on his own.

Happily, there survives an account of the flight that Clark set down shortly after arriving back in New Zealand. Apparently it was compiled for whenever the intrepid aviator might be called upon to give a talk about the flight.[10] With the kind permission of the Clark family we present it here in its entirety.

"CHOCKS AWAY . . . !

When I took off from Lympne at daybreak [on October 26] I had that pleasant feeling of uncertainty one usually experiences when undertaking some new adventure. Several friends had previously asked me how far I was going and whether I would complete my flight to New Zealand by doing the Tasman crossing. I replied that I had not the faintest idea how far I would get, but that at least I hoped to get some of the way. So when I landed at Brindisi [in southern Italy] that night, to schedule, and learned that [Imperial Airways' Short S.23] *Canopus* had had to turn back on account of the storm, and that damage had been caused by it on the [ocean liner] *Queen Mary*, I was naturally rather encouraged by my own safe arrival.[11]

The day, however, had not been without its excitements. To begin with, I had only flown my Percival Gull for five hours [sic] beforehand, and had never taken off with a heavy load of petrol, but we took off with ease and were soon heading south. As on most subsequent days, in order to obviate the delay necessitated by a midday landing and its attendant customs formalities etc, I took my lunch with me and ate it during the flight. This was no mean feat sometimes during bumpy weather, and I spilt a certain amount of tea over myself until I learned the art of using a large piece of rag as a table napkin.

I would have very much liked a Vega Gull for my flight, but did not wish to risk too much with my comparatively small experience, so I contented myself with a slower machine, and had to spend longer hours in the air than I would have done otherwise.

Before leaving England I had been advised to do a little night flying in preparation for my flight, as I had never done any before; and,

ABOVE ***Clark pilots ZK-AES over Christchurch during a pleasure flight in January 1937, a few months after his epic solo flight from the UK to New Zealand. Although some sources claim that the aircraft was at some point fitted with a Gipsy Six, its official New Zealand documentation clearly marks the Gull as being powered by a "118/122 h.p." Gipsy Major.***

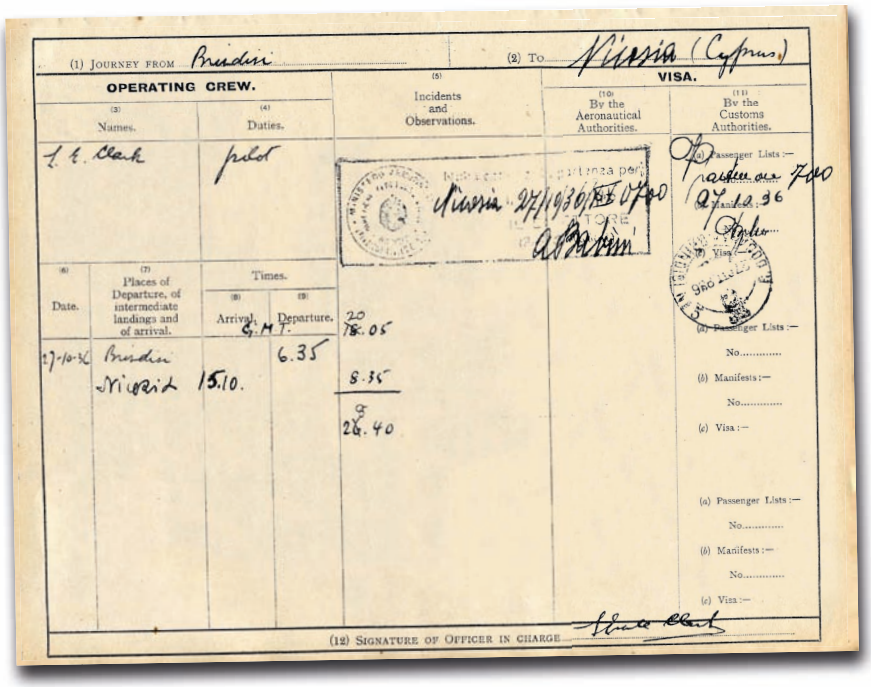
although I realised the necessity of this, I was so rushed that I did not have time to do any before my departure. So it was with a certain amount of dismay that I found, contrary to the information given in my homemade table of sunset times, that it was going to be dark by the time I got to Brindisi. It was well and truly dark when I arrived, as the moon was hidden; but I was able to locate an aerodrome by means of the obstruction lights on the hangars, and after I had circled and signalled with my torch for some time, a single motor car came out and switched on its headlamps, enabling me to land.

Well, I found that I had landed on a military aerodrome without navigation lights and had probably been flying over prohibited areas; so when I was marched along to a room where they unlocked a large iron door, I thought it quite possible that I was going to spend the night in a cell. I was quite mistaken, however, for I was treated most hospitably, praised for my good landing and even given drinks. They rang up the police and customs authorities, who put through the necessary formalities as soon as possible, and I departed to a hotel for the night. I forgot to mention that owing, I suppose, to a very moist atmosphere, my windows began to fog up before landing, and I had to put my head outside in order to see to land.

ON INTO THE MEDITERRANEAN

I did not get a very early start next morning as I had to fly first to the proper customs aerodrome to complete the formalities and refuel there. That night found me at Nicosia in Cyprus; a pleasant day's flight, though nearly all over water. Here I had trouble in locating the aerodrome; it was not my fault altogether, as it happened to be eight or ten miles [13–16km] distant from the town, and I had tried without success to obtain a plan of it before leaving England. The first person to greet me was a New Zealander in charge of a flight which had landed that afternoon from Palestine. He was quite excited at seeing a machine with an NZ registration, and we had a pleasant evening together. The day's flight over the sunny Mediterranean had been most interesting, and made me long to spend a few days in some of the Greek islands I passed.

The next two days, to Bushire [in Iran] and Karachi [then in India], were dull and monotonous, the first being mainly over flat barren country, and the second over mountainous desert [which was] remarkable, however, for its peculiar hill formation. Here one could distinguish extraordinary resemblances to cathedrals, skyscrapers and those long rows of houses, all joined to one another and often built like steps up the side of a hill which so disfigure the landscape in many parts of England. Worthy of mention also were the small whirlwinds of sand, which I think are called "wind-devils" and which appear at intervals in the desert, often rising to a considerable height and causing, I presume, the sandstorms for which that part of



(1) JOURNEY FROM Brindisi (2) TO Nicosia (Cyprus)

OPERATING CREW. VISA.

(3) Names.	(4) Duties.	(5) Incidents and Observations.	(10) By the Aeronautical Authorities.	(11) By the Customs Authorities.
L. F. Clark	pilot	Nicosia 27/10/36		

(6) Date.	(7) Places of Departure, of intermediate landings and of arrival.	Times. (8) Arrival.	(9) Departure.
27-10-36	Brindisi		6.35
	Nicosia	15.10.	

20 15.05 — 8.35 — 26.40

(a) Passenger Lists :— No.....
(b) Manifests :— No.....
(c) Visa :—

(12) SIGNATURE OF OFFICER IN CHARGE L. F. Clark

LEFT ***This page from the Gull's logbook bears the relevant departure and arrival stamps for the 8hr 35min flight from Brindisi on Italy's Adriatic coast to Nicosia on Cyprus, on October 27, 1936.***
CLARK FAMILY VIA ASHBURTON AVIATION MUSEUM

BELOW ***The Gull attracts official interest during Clark's stopover at Darwin. Note the Imperial Airways (IA) Armstrong Whitworth Atalanta, G-ABTI, which may have pushed on from its usual Karachi—Singapore service owing to a problem on the Qantas section of the joint IA/Qantas UK—Australia route.***

the world is notorious. Conditions were very rough and the visibility bad as I neared Karachi, and when I landed there I was fairly easily persuaded to take a day off and stay with more New Zealand friends at the RAF Mess. After all, four days to Karachi was not bad-going at the comparatively slow cruising speed, and my [propeller] spinner was cracked to pieces and a 25hr overhaul would be a good policy.

I should mention here that a bill of health is necessary in this part of the world, and a vaccination certificate [is required] for Australia. I was very fortunate in not being delayed at Bushire for this reason and it was only owing to the kindness of the health authorities in Australia that I was later granted exemption and allowed to continue my flight after landing in Darwin [in Australia's Northern Territory]. I had not been informed about this by the body which makes the necessary arrangements for these flights and I was lucky to escape a most annoying delay in both places.

I might mention here also that some of the maps supplied should be interpreted with a certain amount of latitude. I found them very inaccurate in parts of the Mediterranean. I was highly amused by the native who sprayed the cabin with disinfectant on [my] arrival at Karachi. I suppose it is really necessary, but the way he did it reminded me more of some witchdoctor's antics. First he sprayed the cabin; then with a malicious glint in his eye he saw the locker and gave it one squirt for the sake of appearances. I quite expected him next to undo all the inspection plates and squirt into the wings and fuselage.

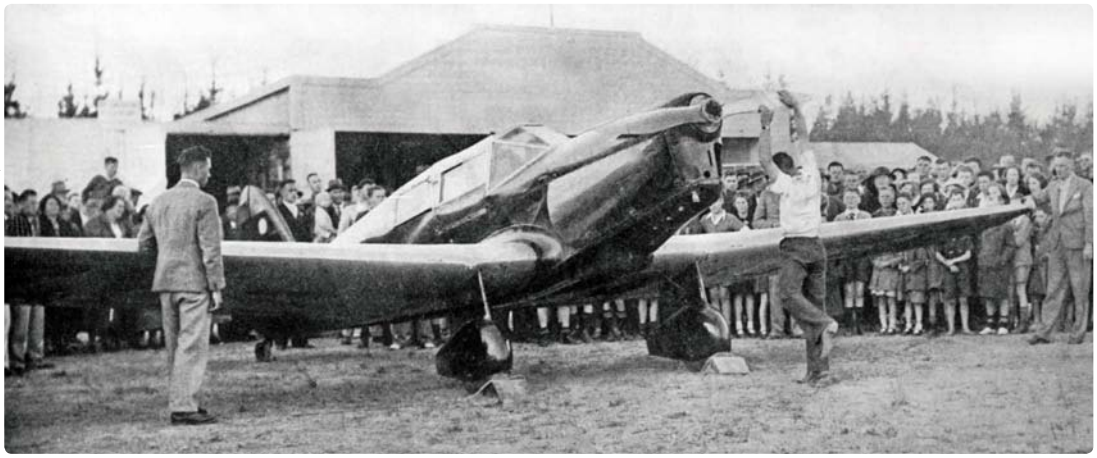
My next day's trip was to Gaya [in north-east India] and I was relieved to find, after flying

"After waiting a week in Sydney for good weather, I took off for New Zealand in the early morning . . . as I had anticipated, the take-off was the only worry. Not only had I lost the moon by this time, but it was cloudy as well, and, with nearly half a ton loaded on my small machine, I had to fly blind from the moment I passed the last flare . . ."

ABOVE ***The November 25, 1936, issue of Auckland newspaper*** **The Weekly News** ***celebrated the completion of Clark's flight back home with a full page of photographs of the intrepid aviator's arrival on New Zealand soil on November 15. Here he is seen being greeted at Blenheim (Omaka) by Marlborough Aero Club's flying instructor Noel Chandler and President Alexander Macnab.***

LEFT ***The "flying farmer" enjoys a welcome cigarette in the clubhouse at Omaka. Clark barely had time to catch his breath, however, as a call came through from the Canterbury Aero Club at Wigram, near Christchurch, requesting that Clark fly the 155 miles (250km) down from Blenheim, despite fading daylight.***

BELOW ***Following his cigarette and a cup of tea at Omaka, Clark got back into the Gull in front of the gathered crowds and had a local flying club member swing the prop before departing for Wigram at around 1900hr local time. Note the absence of the propeller spinner, which had "cracked to pieces" by the time Clark had reached Karachi two weeks before.***



SIR GEORGE GRAY SPECIAL COLLECTIONS, AUCKLAND LIBRARIES

over flooded country for all the latter part of the day, that the aerodrome was a good one with artificially prepared runways. The distortion of the sun's appearance at sunrise is most peculiar in this part of the world; it alters shape like a jellyfish while it is climbing clear of the horizon.

BURMA AND BEYOND

Between Tavoy [in Burma, now Dawei in south-eatern Myanmar] and Alor Star [in northern Malaya, now Malaysia] I was obliged by storms to hug the coastline, but it was not until I reached Palembang [on Sumatra, now part of Indonesia] that I had the worst experience of the trip to date. The surrounding countryside consisted of jungle as far as the eye could see, broken only by rivers and without any ground at all suitable for a forced landing, and I was careless enough to lose my way, with the result that I had not found Palembang by nightfall. However, I had an idea of the direction of my error, and found the town at length.

I was certainly relieved to see the lights in the distance, with the only alternative being a forced landing in the most impossible country, although I then had the misgiving that it might be a forest fire. When I reached the town there was no sign of any illumination indicating the aerodrome. I discovered later that they did not even possess a Very pistol, but I spotted a place which turned out be the local golf club, and when I began circling the place the members proceeded to drive their cars round to one of the fairways, which they illuminated with their headlamps.

I came down to land once or twice, but did not dare to do so as I was completely dazzled by [the headlamps of the] cars, which they had unfortunately stationed all round the ground. I dived repeatedly at the cars at one end to try to induce them to move, but without avail; so after gaining some height to write a note to drop to them, I saw to my relief a symmetrical group of lights in the distance, which turned out to be the aerodrome now lit by flares. The rest was easy.

Batavia [on Java, now Jakarta, capital of Indonesia] was my next stop. [It was] quite a short trip as I could not make Koepang [now Kupang on West Timor] in one day, and in any case I was quite glad of a good sleep. Koepang was my destination the following day and the morning after I made the comparatively short hop across the Timor Sea to Darwin. I was disappointed at not seeing the sharks I had heard so much about, although I kept a good lookout for them. However, I had seen a school of whales the previous day, and although I dived low at them they took not the slightest notice.

Having landed at Darwin, after putting to flight the geese which camp on the landing ground, I was informed that I would have to be vaccinated as I had no vaccination certificate. This came as rather a shock, as the after-effects would have developed a few days later. In fact, just at the time of crossing the Tasman. The medical authorities were very kind, however, and wired to Canberra for special exemption, which was subsequently granted. Thereupon the quarantine flag was hauled down, and I was allowed to depart the next morning.

The trip across Australia was monotonous and very bumpy, and I was glad to arrive at Mascot [in Sydney]. The last few hundred miles before Sydney were unpleasant on account of the bad visibility caused by bush fires. At times I had to fly blind and at other times I had to fly low and read the names on railway stations to get my position. When one considers how simple air touring has become in Europe, and even in foreign countries on the way to Australia, it seems to me a great pity that the customs authorities in Australia should find it necessary to subject one to more "red tape" than any foreign country en route. I am not referring to the question of vaccination, in which I was entirely in the wrong for not knowing it was previously necessary; nor to the aviation authorities. The Royal Australian Air Force [RAAF] did everything [it] possibly could for me for my take-off at Richmond for the Tasman crossing, for which I am extremely grateful.

THE LAST LEG

After waiting a week in Sydney for a good weather report, I took off for New Zealand in the early morning. Exactly as I had anticipated, the take-off was the only worry on this trip. Not only had I lost the moon by this time, but it was cloudy as well, and, with nearly half a ton loaded on my small machine, I had to fly blind from the moment I passed the last flare. Of course, to an experienced pilot this would have presented no great difficulty, but I did not like it much, and was relieved to get a horizon and daylight about an hour and a half later.

From then on I had no qualms, but could not help feeling pleased 12hr later, not so much at the sight of land, as at the position of it. There was Cape Farewell, exactly where it should have been, on my starboard bow; so exactly, in fact, that it seemed too good to be true. I had stated before leaving Richmond that I would try to make a track of 110° true, and I do not think I was more than five miles (8km) off my course in the 1,440 miles (2,310km) of the crossing. I had headwinds all the way, changing from NE to E to SE, which is unusual in the Tasman, the prevailing wind being westerly. I landed first at Blenheim [Omaka], where I was welcomed and

SIR GEORGE GRAY SPECIAL COLLECTIONS, AUCKLAND LIBRARIES

LEFT ***A by-now somewhat weary-looking Ernle Clark is photographed in the cockpit of ZK-AES after his arrival in the dark at Wigram at 2035hr on November 15, having flown for more than 14hr that day. Note the forward section of the extra fuel tank fitted behind the pilot's seat by Percival, to give the Gull the extra range needed to complete the UK—NZ flight.***

fed, and then went on to Christchurch [Wigram], where I landed in the dark, an hour and a half later, and received a tumultuous and very unexpected welcome.

I do not advocate making a habit of sea crossings with single-engined machines, but, apart from this difficulty, I do not think the average private owner, provided he is reasonably competent and has a good machine, should have much difficulty in flying to Australia, although he must be prepared to wait for good weather reports at times. I found the whole trip very enjoyable, and a grand way of seeing some of the world, although it became monotonous occasionally when the country was uninteresting. Another time, were I not in a hurry, I should prefer to go with a friend and take longer over it.

I cannot close without referring to the assistance given by Shell throughout the route. I was never kept waiting a minute for petrol, and no matter what needed doing the local Shell representative would see to it. [On] mornings when I took off in the dark they would be there with a car and lamps to mark the runway, and I may fairly say the Shell organisation is a necessity for an undelayed flight.

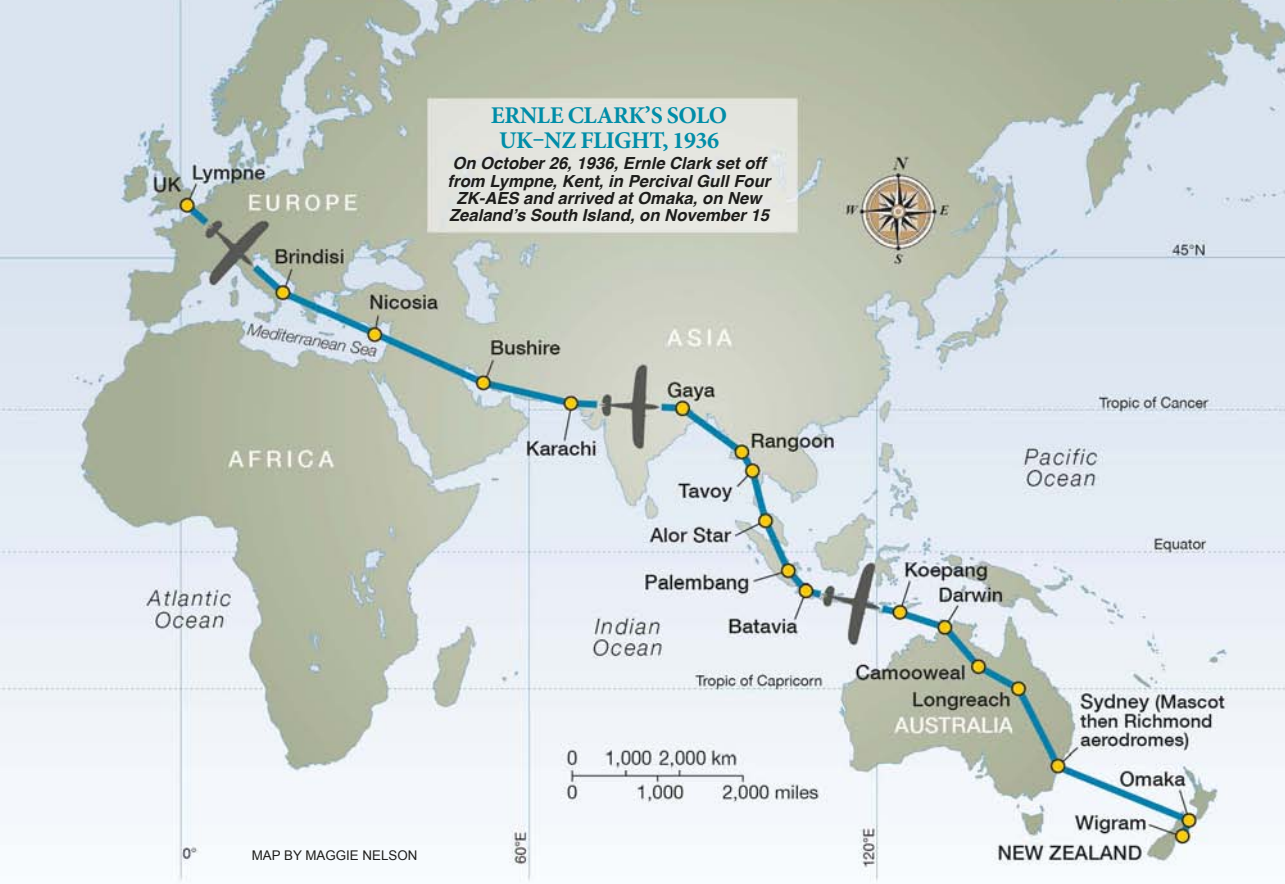
The machine and engine are too well-known to need more praise, but as I do not think I have mentioned them once yet, I can only say that I had absolute faith in them throughout, and it was not misplaced. I would also like to express my appreciation of the help given by the AA in arranging the trip, and by Stanford Ltd in helping me with my maps. And I cannot close without a reference to the friendly face of my Husun P.4 compass, which did its work perfectly and made flying by compass a simple task. ❞

POSTSCRIPT

Ernle's journey could have taken a little longer, as during his Sydney stopover he volunteered to conduct an aerial search over the Tasman looking for a yacht called *Viking* that had gone missing on its way to Lord Howe Island. The authorities declined the offer, however, considering the undertaking in a single-engined machine too risky. The *Viking* was never found. Meanwhile, on November 11, Ernle had enlisted the services of prominent pioneering pilot and navigator Capt P. Gordon Taylor to assist him with swinging the Gull's compass in preparation for the Tasman crossing.[12] It was a wise precaution, Ernle commenting that "we found that on some points it was out by as much as 7°".[13] Taylor may be one of those featured in a short film that was made of Ernle and the Gull during their stopover at Mascot.[14]

Ernle saw no point in carrying a rubber dinghy with him, as if he came down in the Tasman it would have proved useless. Instead, he carried a tomahawk and hacksaw, not "for cutting away the engine if he should be forced down on the sea", as a cabled item from Sydney had reported, but to cut a hole in the fuselage if necessary and "to cut the petrol pipe above the tap".[15] Although the New Zealander had landed at Mascot at the end of his flight from Darwin, he persuaded the RAAF, as had Batten, to allow him to take off for New Zealand from its nearby base of Richmond. The smaller Mascot carried with it the risk of the heavily loaded Gull failing to clear its boundary fences, he thought.

When it was learnt that Ernle was setting course for Cook Strait, the Marlborough Aero Club correctly assumed that the Gull would land at its Omaka airfield at Blenheim. Ernle was therefore met in the air on his approach and escorted in by the club's D.H.60G Moth ZK-ADA, flown by instructor Noel E. Chandler and Waco UOC ZK-AEL flown by Plt Off A.E. ("Bill") Willis. Some 300 people were on hand to welcome the aviator when he touched down at 1820hr. He had anticipated staying the night but, while enjoying a cup of tea and sandwich accompanied by a cigarette, he received a telephone call from the secretary of the Canterbury Aero Club explaining that a large crowd was already gathering at Wigram in expectation of his arrival there in a few hours. The official reception being organised in the flyer's honour included a welcome by Christchurch's mayor, John Beanland. Ernle had



THE UK—NZ JOURNEY LOGBOOK OF PERCIVAL GULL FOUR ZK-AES

Date (NB times are **GMT**)	**From**	**To**	**Departure**	**Arrival**	**Flight time**
Monday, October 26	Lympne	Brindisi*	0620hr	1740hr**	10hr 20min
Tuesday, October 27	Brindisi	Nicosia*	0635hr	1510hr	8hr 35min
Wednesday, October 28	Nicosia	Bushire	0343hr	1323hr	9hr 40min
Thursday, October 29	Bushire	Karachi*	0310hr	1250hr	9hr 40min
Saturday, October 31	Karachi	Gaya	0115hr	1100hr	9hr 45min
Sunday, November 1	Gaya	Rangoon	2215hr	0625hr	8hr 10min
	Rangoon	Tavoy	0825hr	1055hr	2hr 30min
Monday, November 2	Tavoy	Alor Star	2055hr	0235hr	5hr 40min
	Alor Star	Palembang	0415hr	1200hr	7hr 45min
Tuesday, November 3	Palembang	Batavia	0653hr	0943hr	2hr 50min
Wednesday, November 4	Batavia	Koepang*	2105hr	0750hr	10hr 45min
Thursday, November 5	Koepang	Darwin*	2000hr	0050hr	4hr 50min
Friday, November 6	Darwin	Camooweal	2025hr	0240hr	6hr 15min
	Camooweal	Longreach	0347hr	0807hr	4hr 20min
Saturday, November 7	Longreach	Mascot*	2105hr	0435hr	7hr 30min
Wednesday, November 11	local flight		0415hr	0515hr	60min
Saturday, November 14	local flight		0342hr	0412hr	30min
	Mascot	Richmond*	0535hr	0605hr	30min
Sunday, November 15	Richmond	Omaka	1730hr	0620hr	12hr 50min
	Omaka	Wigram	0700hr	0835hr	1hr 35min
(Following times are local)					
Tuesday, November 17	Wigram	Waikari	1350hr	1435hr	45min

* Some accounts state that Clark followed the route Jean Batten had taken a few weeks earlier. In fact, her route varied slightly and the asterisks here indicate the only aerodromes that both used on their respective flights to New Zealand. Batten landed at one more aerodrome than did Clark before reaching New Zealand. Ernle's total flight time from Lympne to Blenheim, discounting the two local flights at Sydney, was 121hr 55min.

** Arrival time appears in the log book as "16.40 (17.20)", although 17.20 should read 17.40.

already flown for more than 14hr that day, but after a brief discussion he announced that he'd "give it a pop" and head for Wigram, even as darkness was about to fall.

ON TO WIGRAM

His plans for a hurried departure were then briefly interrupted by a telephone call from *The Dominion* newspaper in Wellington. He spared the reporter 10min, saying about the Tasman crossing: "It was nothing very much, I just flew across — that's about all . . . I'm afraid I'm in a tearing hurry. I am flying on straightaway to Wigram. I must go now".[16] Just 40min after landing at Omaka he was airborne once again and heading for Wigram.

By the time the Gull reached Wigram, the CAC had arranged for motor cars with their lights on to be positioned in a half-square, and some flares to be lit in the middle of the airfield. Despite these arrangements it was only with some difficulty that Ernle was finally able to locate the landing area and bring the Gull down to a safe landing at the end of its 14,000-mile (22,500km) journey at 2035hr. A newspaper report described the amazing scene that unfolded before him as he brought ZK-AES to a halt:

"A vast crowd of between 20,000 and 30,000 people gave the North Canterbury farmer-flyer one of the most tumultuous welcomes any flyer has received here. Thousands broke the barriers and, rushing madly across the field in the dark shouting and cheering, surrounded his machine until the engine had to be stopped. Only after a brief but firm appeal from the flyer did the surging crowd part to let his aeroplane through, but for the moment the crowd was definitely out of hand. Thousands tried to shake Mr Clark's hand as the officials ushered him with difficulty to the clubhouse for the official welcome."[17]

Looking lean, bronzed and wearing a well-worn pair of carpet slippers as he stepped out of the Gull, Ernle was then faced with a barrage of questions, welcoming speeches and even a live radio interview which, given his shy nature, he probably found far more daunting than anything he had encountered during the flight.

After handing over a small "air mail" package he had brought from Sydney for delivery to Christchurch newspaper *The Press*, containing photographs of the MCC vs New South Wales cricket match played at the Sydney cricket ground that day, Ernle finally got away to the city for a well-earned sleep; it had been a very long day indeed. Clark intended to fly to his farm at Waikari the next day, but such was the "formidable pile of congratulatory letters and telegrams" that he postponed this by a day. When he finally landed at Iffley on the Tuesday afternoon there was yet another reception to be faced, with about 300–400 people present, including schoolchildren and the local MP awaiting him on the paddock there.

ACKNOWLEDGMENTS *The author would like to thank Ernle Clark's children — Caroline, Charles and David — for their assistance in the preparation of this article. Thanks also go to Alistair Perkins of the Ashburton Aviation Museum and to Jane Orphan at the Omaka Aviation Heritage Centre*

PERCIVAL D.2 GULL FOUR DATA

Dimensions		
Span	36ft 2in	(11·02m)
Length	24ft 9in	(7·54m)
Height	7ft 4½in	(2·25m)
Wing area	169ft²	(15·7m²)
Weights		
Empty	1,290lb	(585kg)
Loaded	2,300lb	(1,043kg)
Performance		
Maximum speed	172 m.p.h.	(277km/h)
Cruising speed	152 m.p.h.	(245km/h)
Stalling speed	43 m.p.h.	(69km/h)
Rate of climb	850ft/min	(7·3m/sec)
Service ceiling	16,000ft	(4,900m)

Ernle Clark (second from left) poses with members of the Canterbury Aero Club at Wigram beside ZK-AES. Clark went back to the UK before the outbreak of war and became an RAF officer, flying unarmed photo-reconnaissance Spitfires in France in 1940, before being posted to transatlantic ferrying operations. He transferred to the RNZAF in January 1944 and ended the war with a DFC.

AIR FORCE MUSEUM OF NEW ZEALAND

This article was originally published in the September 2017 issue of the Aviation Historical Society of New Zealand's excellent quarterly journal ***The Aero Historian***; for more information visit the website at **www.ahsnz.tripod.com**

PETER LEWIS COLLECTION VIA DON NOBLE

ABOVE ***The Gull in the overall silver scheme with black cowling and detailing it acquired some time after Clark sold it to New Zealand's Civil Aviation Dept, Ernle having flown a total of more than 263hr in the aircraft. The Gull was subsequently used "to facilitate inspections by the Air Staff" until it was impressed into military service as NZ572 in November 1939. It was finally damaged beyond repair during a forced landing, the result of engine failure on take-off from Hobsonville, near Auckland, on July 18, 1940. The remains of this historic aircraft were burnt.***

ENDNOTE REFERENCES

1 After arrival in England the following year Clark was issued with an equivalent Great Britain & Northern Ireland "A" Licence (No 9561) on May 14, 1936
2 Logbook; Yapton Aero Club notes in *Flight*, June 11, 1936
3 Constructed in 1929, the Avian was previously owned by Welshman John L. Bebb. Its new owner when Clark sold it was the Horton Kirby Flying Club Ltd
4 Later, Clark estimated that the running costs for his UK—New Zealand flight were "about £200"
5 *The Press*, Christchurch, November 16, 1936
6 On October 12, 1937, Randolph was killed when G-AEKD crashed at Jaipur, India; his passenger suffered serious injuries but survived
7 According to the 1934 edition of *Jane's All The World's Aircraft*, the Gull Four's range with "standard tankage" of 31·5gal (143lit) was 500 miles (800km) or 640 miles (1,030km) with "maximum tankage" of 40gal (182lit). The fuel was accommodated in two tanks, one in each wing. On November 14, 1936, *The Sydney Morning Herald* reported that for the Tasman crossing Clark "will fill the wing tanks each with 30gal [136lit] of petrol, and the special tank in the cockpit with 55gal [250lit], making a total of 115gal [523lit]". In his book *Wings Across the Tasman* (A.H. & A.W. Reed, 1953), Leslie Jillett erroneously states that there were "three tanks holding 30gal each, and an extra tank holding 55gal in the cockpit, [for a] total of 145gal [659lit]"
8 *Flight*, October 15, 1936
9 *The Press*, October 27, 1936
10 One such talk was given to the Canterbury Aero Club on November 25, 1936
11 Imperial Airways' Short S.23 G-ADHL *Canopus*, the first of the Empire Flying Boats, was engaged on the type's first proving flight to the Mediterranean before entry into scheduled service. It encountered stormy weather en route to Alexandria and was forced to turn back to Brindisi, arriving there safely without damage at 1600hr
12 Taylor was closely associated with Charles Kingsford Smith and Charles Ulm. The previous year he played a critical role in the saving of the former's Fokker F.VIIb/3m trimotor, *Southern Cross*, from disaster over the Tasman, when on six occasions during the flight he climbed out along a connecting strut to transfer oil from the disabled starboard engine to the operating port engine. In 1937 Taylor was awarded the Empire Gallantry Medal for this heroic act
13 *The Sydney Morning Herald*, November 12, 1936
14 A print of the 50sec film is held by Ngā Taonga Sound & Vision, Wellington
15 *The Press*, November 17, 1936
16 *The Press*, November 16, 1936
17 Unidentified newspaper clipping. The crowd was at least three times that which had welcomed Batten at Mangere a month earlier, probably because Ernle had arrived on a Sunday evening, when most citizens were not working, whereas the aviatrix arrived late on a Friday afternoon

THE CONVAIR 990 AND Garuda INDONESIAN AIRWAYS

During 1963–64 Indonesian national airline Garuda joined the ranks of the jet set when it took delivery of three state-of-the-art Convair 990A jetliners, at the time one of the fastest airliners in the world, if considerably less economical than its Boeing and Douglas rivals. Indonesian aviation historian **SUDIRO SUMBODO** profiles the type's career with Garuda

JON PROCTOR COLLECTION

CAPT M. SYAFEI COLLECTION VIA AUTHOR

THE ORIGINS OF Indonesia's graduation into the jet set reaches back to a visit by the nation's Minister of Air Transport, Air Marshal Iskandar (Managing Director of Garuda Indonesian Airways 1959–61) to the Lockheed factory at Burbank, California, in 1961, to announce the purchase of three L-188 Electra turboprop airliners. Another visit to the USA followed two years later, this time to General Dynamics' Convair factory at San Diego, to sign a contract for the same number of Convair 990A jetliners. To evaluate and test-fly the 990A, Garuda sent the same team that had delivered the Electras in 1961: Managing Director Capt Partono (team leader); Captains M. Syafei, Sudjalmo and Sastyo (pilots); flight engineers Azwar Apin and Surochmad and two engineers.

The Garuda evaluation team spent a month in San Diego acquiring the necessary type ratings, undergoing instruction in jet engine technology and test-flying the sleek four-engined jetliner. Having completed their training, the Indonesians, accompanied by pilots and technicians from Convair, delivered the first of Garuda's 990As, PK-GJC (c/n 30-10-37), to Kemayoran Airport, Jakarta, following fuel stops at Wake Island and Guam, on September 3, 1963. The aircraft, named *Majapahit* in honour of the ancient Javanese Majapahit Empire, was given a warm welcome by members of Garuda's management, Ministry of Transport officials and the people of Jakarta.

The next to be delivered was PK-GJB (c/n 30-10-4), named *Sriwijaya* after the historic South Sumatran city state, the aircraft arriving in Jakarta on October 21 the same year. The last to arrive was PK-GJA (c/n 30-10-3), named *Pajajaran* in honour of the ancient capital of the Sunda kingdom on West Java, delivered on January 24, 1964. The acquisition of the state-of-the-art jetliners not only gave Garuda international prestige, but also made the political point that Indonesia was a modern developed country capable of operating the most up-to-date jet aircraft.

INTO SERVICE

From mid-1961 the Electras had been operating Garuda's "Emerald Service" between Jakarta, Hong Kong and Tokyo, initially via Manila in the Philippines and, from 1963, with a stop at Bangkok in Thailand on the Hong Kong service. The arrival of the Convairs during 1963–64, however, saw the replacement of the Electras on the Emerald routes, the turboprops switching to the airline's domestic and regional routes.

In January 1965 Garuda expanded again, establishing services to Canton (Guangzhou) in southern China via Phnom Penh, the capital of Cambodia, and the Dutch capital Amsterdam via Bangkok, Bombay (now Mumbai), Karachi, Cairo and Rome (later Prague and Paris or Frankfurt),

OPPOSITE PAGE ***Garuda's first Convair 990A, PK-GJC*** **Majapahit,** ***gleaming in the California sun at San Diego before its delivery to Indonesia in September 1963.*** **TOP** ***Garuda's Convair 990A evaluation team, led by Capt Partono (eighth from right in pale suit), at the General Dynamics Convair factory at San Diego just before delivery.***

PETER KEATING © A FLYING HISTORY

CAPT M. SYAFEI COLLECTION VIA AUTHOR

ABOVE ***The last of the Garuda 990As to be delivered, PK-GJA*** **Pajajaran** ***is seen here at Hong Kong being prepared for its next flight on the Jakarta—Tokyo service via Bangkok and Manila, in February 1965. In terms of performance, the 990's only contemporary rival was the British Hawker Siddeley Trident, which could equal the American jetliner's Mach 0·9+ cruising speed.***

LEFT ***In January 1965 Garuda launched its weekly Jakarta—Amsterdam Convair 990 service. Indonesian Minister of Air Transport Air Marshal Iskandar, seen here in the right-hand seat of PK-GJA, participated in the inaugural flight on January 6.***

BELOW ***The crew of*** **Pajajaran**, ***including Air Marshal Iskandar (third from left) and pilots Syafei (seventh from left) and Tumbelaka (second from right), are greeted by KLM President Gerhard van der Wal (second from left) at Amsterdam on January 6, 1965.***

CAPT M. SYAFEI COLLECTION VIA AUTHOR

COURTESY OF THE SAN DIEGO AIR & SPACE MUSEUM

ABOVE ***One of a sequence of superb General Dynamics promotional photographs taken of PK-GJC in 1963. Although RAF Javelin crews were more accustomed to intercepting Indonesian Tupolev Tu-16 bombers during the 1963–66 Indonesian-Malaysian Confrontation, they also were called on to usher Garuda 990s back on to airways.***

in a pool arrangement with Dutch national airline KLM. The Jakarta—Amsterdam service was officially inaugurated on January 6, 1965, when Capts Syafei (pilot in command) and Tumbelaka (copilot) and Air Marshal Iskandar (third pilot) flew the route in PK-GJA *Pajajaran*. The Convair-operated Amsterdam service departed Jakarta for Schiphol once a week, frequency increasing to twice a week shortly afterwards, the airline offering two class configurations on the jetliners, First Class and Economy, on its long-haul routes.

As well as operating on Garuda's services to Asia and Europe, the Convairs would also be used by the Indonesian leader Sukarno as his presidential aircraft while making official visits abroad. Before the arrival of the Convairs, Sukarno leased Douglas DC-8s or Boeing 707s from Pan Am, but the acquisition of the 990As provided the President with his own jet transport, and he used the aircraft for official visits to Cambodia, North Korea, Japan and Algeria.

The Garuda 990As also undertook military duties as part of the *Angkatan Udara Republik Indonesia* (AURI — Indonesian Air Force) auxiliary transport unit Wing Garuda 011, which comprised three squadrons operated by Garuda crews during Indonesia's Dwikora Campaign against UK-backed Malaysia during 1963–66. Garuda's 990A pilots were given the military rank of Major by the country's military high command (KOTI) and tasked with limited photo-reconnaissance duties, using hand-held cameras to spy on activities on the Malay Peninsula while performing scheduled daylight services to Hong Kong and Tokyo. The RAF was well aware of this, and, on the airliners' return flights to Jakarta from Tokyo, Gloster Javelins from RAAF Butterworth were frequently scrambled to escort the Convairs back on to their civil routes.

FAST — BUT UNECONOMICAL

The Convair 990 was a development of the company's 880 design, a competitor to Boeing's 707 and Douglas's DC-8 four-engined airliners. Convair, a subsidiary of General Dynamics, had learned a lot from the development of supersonic military aircraft, including the F-106 Delta Dart fighter and B-58 Hustler bomber, and reasoned that speed was the key to success with its new airliner. Accordingly, the 880's fuselage was

Garuda's second Convair 990A, PK-GJB* Sriwijaya, *was delivered to Jakarta on October 21, 1963, and is seen here being refuelled at Tokyo-Haneda in February 1965. Despite the 990's blistering performance, it struggled to compete with its larger and more economical Boeing and Douglas rivals, and only 37 examples were ultimately built. PETER KEATING © A FLYING HISTORY

COURTESY OF THE SAN DIEGO AIR & SPACE MUSEUM

ABOVE *Showing off the type's distinctive "Küchemann's carrots" to good effect, factory-fresh PK-GJC soars over the southern Californian mesa before its delivery flight to Indonesia. The anti-shock bodies on the wing's trailing edge reduced a build-up of wave drag experienced by the original 990 design at transonic speeds.*

LEFT *The stylish 1964 Garuda summer timetable featured the Convair 990's unmistakable plan view on its opening flap, the rear flap detailing contact information for the company's offices in Jakarta, Tokyo, Hong Kong, Bangkok, Manila and San Francisco.* DAVID H. STRINGER COLLECTION

BELOW Majapahit *on the San Diego runway. The General Electric CJ-805-23 turbofans, with the fans mounted aft of the engine, were a development of the Convair 880's pure turbojets and offered greater take-off thrust and lower fuel consumption during cruise conditions, the latter being an important factor in the type's economic viability.*
COURTESY OF THE SAN DIEGO AIR & SPACE MUSEUM

COURTESY OF THE SAN DIEGO AIR & SPACE MUSEUM

ABOVE ***The "office" of Garuda Convair 990A PK-GJC at San Diego. A standard flight crew for the 990 comprised a pilot, copilot and flight engineer and often also included an observer or third pilot. The flight instrumentation was well laid out and the view from the cockpit was good, making the type a firm favourite with those selected to fly it.***

narrower than its rivals, offering a capacity of 88–110 passengers in contrast to the 175+ capacity of the 707 and DC-8.

After experiencing sluggish sales with the 880, Convair began developing a stretched version to meet the specific demands of American Airlines, which placed an order for 25 examples of the new variant, still at that time known as the Model 600, in July 1958. The new design introduced a number of improvements, including better landing and take-off capabilities through the incorporation of larger trailing-edge flaps and expanded leading-edge devices. The wing area was increased from 2,200ft² to 2,250ft², but changes in the leading and trailing edges enabled the 990 to have a thinner wing than its progenitor. The wing sweep and dihedral, however, remained the same.

The new variant was fitted with General Electric CJ-805-23 engines, an aft-fan modification of the 880's CJ-805-3 turbojets, and a civil variant of the J79 powerplant used on the B-58. With the new engines of greater thrust and an aerodynamically improved wing, it was estimated that the 990 would be capable of speeds of up to Mach 0·91. However, the air flowing over the wing became supersonic, creating a shockwave which produced air separation over the trailing edge, leading to an increase in drag. To cure this problem, Convair, in association with NACA, added two anti-shock bodies (known as "Küchemann Carrots" after Royal Aircraft Establishment aerodynamicist Dietrich Küchemann) extending rearwards from the trailing edge of each wing. These diminished the shockwave and reduced drag, and also offered additional fuel storage, thereby extending the aircraft's range. The 990 was 10ft 1in (3·07m) longer than its predecessor, the stretch allowing the accommodation of 96–121 passengers, and the fin was 3ft 6in (1·06m) taller than that of the 880, although the span — 120ft 0in (36·6m) — remained the same.

The prototype 990, N5601, was rolled out of the San Diego factory on November 23, 1960, and made its first flight on January 24, 1961. Performance of the aircraft during its test programme was disappointing, however, and extensive modifications had to be made after dangerous vibration was experienced in the engine nacelles at high speed. Research undertaken at Cornell University's Aeronautical Laboratory led to changes in the nacelle design, which were incorporated into the 990A variant. American Airlines nevertheless reduced its order to 15 machines, with Swissair ordering seven 990As (eventually acquiring another), the first of which was delivered in January 1962. The Swiss

PETER KEATING © A FLYING HISTORY

ABOVE ***With Lion Rock towering above the airport at Kai Tak, PK-GJA*** **Pajajaran** ***awaits its next onward flight from Hong Kong in February 1965. Three years later this aircraft was lost with all hands when it crashed shortly after take-off from Bombay on a Jakarta—Amsterdam service. Little appears to be have been reported about the cause.***

airline made the first passenger flight of the Convair 990A on March 9, 1962, followed nine days later by American Airlines.

THE BOMBAY TRAGEDY

The first 990A casualty was American Airlines' N5616 (c/n 30-10-28), which was burned out on May 30, 1963, following an auxiliary power unit fire on the ground at Newark Airport, New Jersey. The next notable 990 incident was far more serious, however.

On May 28, 1968, PK-GJA *Pajajaran*, with Capt Abdul Rohim at the controls, crashed, reportedly in a near-vertical attitude, 4½min after take-off from Bombay's Santacruz Airport, bound for Karachi. All 29 people aboard (14 crew and 15 passengers) were killed, along with a villager on the ground, some 23 miles (37km) north of the airport. As a result, Garuda temporarily grounded its fleet of 990As and the Amsterdam service was suspended. When the service was resumed it was not with either of the remaining 990s but with a DC-8 leased from KLM in 1966 following the failure of Garuda's bid to purchase two of the Douglas jetliners, owing to severe financial constraints. Garuda ultimately leased four DC-8s from KLM, by which time the 990s had been limited to serving domestic and Asian routes only.

Partly as a result of the Bombay tragedy and partly because of Indonesia's rapidly mounting political and economic crises in the wake of the Indonesian-Malaysian confrontation, Garuda suffered severe financial difficulties during the mid-1960s and almost went bankrupt. However, new management under the leadership of Managing Director and Indonesian aviation pioneer Wiweko Soepono (see *Indonesia's Fledgling Insects* in *TAH21*) introduced a massive efficiency campaign, part of which included removing the uneconomical Convair 990As from service, the type officially ending its Garuda career in 1973.

Despite its drawbacks in terms of efficiency and profitability, the shapely Convair 990 is still regarded with much fondness by aviation enthusiasts, many claiming it as their favourite airliner. Passengers enjoyed the luxurious and comparatively quiet cabin, while pilots who flew it enjoyed its modern and comfortable cockpit and exceptional performance. For the

The first of Garuda's three Convair 990As to be delivered, PK-GJC, named **Majapahit** ***in Indonesian service, was operated by the airline for a comparatively short period before being retired along with PK-GJB in 1973, although both had been in storage in Jakarta for some time. Artwork by JUANITA FRANZI / AERO ILLUSTRATIONS © 2018***

TAH ARCHIVE

ABOVE ***Garuda's two remaining 990As were sold to California Airmotive in 1973, PK-GJB coming to grief on Guam during its delivery flight that September. The other, PK-GJC, was eventually acquired by NASA to become N712NA, named*** **Galileo II,** ***as seen here at the Paris Air Salon in June 1977. It was damaged beyond repair in 1985.***

financial department, however, the 990 was eye-wateringly expensive to operate, and ended up being a lower-capacity, higher fuel-consuming version of the Boeing and Douglas jets. It was an æsthetic masterpiece — and a financial disaster.

AFTER GARUDA

Garuda's remaining two Convair 990s were sold to California Airmotive Corp in June 1973 after a long period in storage at Jakarta. Unfortunately PK-GJB, re-registered in the USA as N7876, crashed on landing at Guam during its delivery flight to the USA on September 10, 1973. After an instrument approach during a severe thunderstorm, the aircraft touched down but veered to port and hit a building and a fire truck. All four of the crew escaped with minor injuries.

After being ferried to Hong Kong for refurbishment and modification, PK-GJC was re-registered as N7878 and delivered to the USA in late 1973. It was acquired by NASA, with which it became N712NA, named *Galileo II*, and used for extensive flight research duties.

On July 17, 1985, the aircraft suffered a failure of the front two tyres on the starboard main undercarriage unit during a take-off roll at March AFB in California. As a result an intense fire started, fed by leakage from the puncture of a starboard wing fuel tank forward of the mainwheel unit. The pilot rejected the take-off at around 140kt (rotation speed was around 155kt) and brought the aircraft to a stop. There were no injuries but the aircraft was damaged beyond repair. Ultimately, it was a sad end for all three of Garuda's elegant Convair 990s, once shining symbols of Indonesia's entry into the jet age.

CONVAIR 990A DATA

Powerplant 4 x 16,050lb-static thrust General Electric CJ-805-23B turbofan engines

Dimensions		
Span	120ft 0in	(36·6m)
Length		
overall	139ft 2½in	(42·4m)
fuselage	134ft 9in	(41·07m)
Height	39ft 6in	(12·04m)
Cabin (excl flightdeck)		
length	98ft 9in	(30·1m)
width	10ft 8in	(3·25m)
height	7ft 1in	(2·15m)
Wheelbase	57ft 2½in	(17·43m)
Wheel track	19ft 11in	(6·07m)
Wing area	2,250ft²	(209m²)
Weights		
Basic operating	120,900lb	(54,840kg)
Maximum take-off	253,000lb	(114,760kg)
Maximum landing	202,000lb	(91,625kg)
Performance		
Maximum level speed at 20,000ft	Mach 0·871	
Maximum permitted diving speed	Mach 0·91	
Economical cruising speed at 35,000ft	Mach 0·84	
Stalling speed with wheels/flaps down	125 m.p.h.	(201km/h)
Take-off distance at max take-off weight	9,800ft	(2,990m)
Landing distance with 170,000lb fuel	5,400ft	(1,650m)
Service ceiling	41,000ft	(12,500m)
Normal range with 25,770lb payload	3,800 miles	(6,120km)

NARVAL

THE DREADED SNCASO SO.8000

"If it looks right, it flies right" goes the old adage — but there are dishonourable exceptions; the SO.8000 Narval may have looked like a state-of-the-art post-war naval strike fighter, but its futuristic appearance belied its dreadful performance and diabolical handling. **JEAN-CHRISTOPHE CARBONEL** charts the development of the only two examples built

THE FAMOUS French aircraft designer Marcel Dassault once opined that a beautiful aircraft should fly beautifully — the SNCASO SO.8000 Narval is conclusive proof that the direct opposite can sometimes be the case. This elegant-looking twin-boomer was designed in the immediate post-war period by a team led by Lucien Servanty of the *Société Nationale des Constructions Aéronautiques du Sud-Ouest* (SNCASO), who had designed the first French jet-powered aircraft, the same company's SO.6000 Triton, and who later came to prominence as one of the designers of Concorde. The engineers responsible for the design of the SO.8000, however, were Messieurs Dupuy and Lemeignan.

A DAUNTLESS REPLACEMENT

The Narval was intended as a carrierborne naval fighter and strike aircraft to replace the *Aéronavale's* Douglas Dauntless aboard France's aircraft carriers (at that time both French aircraft carriers were ex-Royal Navy — *HMS Biter* became *Dixmude,* and *Arromanches* was formerly *HMS Colossus)*. On May 31, 1946, SNCASO received Contract No 5161/46 for the production of five pre-series machines and 65 production examples of the SO.8000. The same month, the project was announced by the aviation press — to remarkably little fanfare. Indeed, to have been more cryptic would have been difficult, magazine *La Revue Aéronautique* describing the new type merely as a "*chasseur au long cours*" (long-range fighter). At about the same time, Contract No 5269/46 was awarded to CGEA to supply three *doublets* (contra-rotating propellers) "for the SO.8000 fitted with Jumo 213 [engine]". From this we can deduce that, at least in the short term, only three aircraft (or two — one doublet could have been reserved for bench testing) were planned.

It also suggests the type of engine selected to power the aircraft. Production of the German wartime Junkers Jumo 213 liquid-cooled V12 inline engine continued in France after the war as the Arsenal 12H. It was not the first choice of the designers, however, who had originally hoped to obtain a Rolls-Royce Griffon (ideally a Griffon 57 or 83, both specially adapted for contra-rotating propellers). This powerplant being unavailable, they turned instead to the locally-designed pre-war-vintage 1,480 h.p. Hispano-Suiza 12Z, development of a post-war variant of which was progressing very slowly. In the end the Arsenal 12H was selected in its place.

The choice of a powerful piston engine instead of a jet engine was understandable in 1946, as the availability and reliability of jet engines was still uncertain. Yet it is probable that the Narval's unusual twin-boom configuration with pusher-configuration propellers would have made conversion to jet power relatively easy. Indeed, an unbuilt variant, designated SO.8010, was intended to receive a Hispano-Suiza licence-built Rolls-Royce Nene jet engine.

In June 1946 *La Revue Aéronautique* provided a little more detail on the SO.8000, describing it as a "long-range naval fighter for carrier operations. It should be fitted with either a Jumo 213A or a Hispano 12Z. One prototype is currently being built". However, the magazine mislabelled it as the "SNCASO 3000 M". Little more was heard on the type thereafter, until magazine *Les Ailes* devoted a full page to it in July 1949. The little bit of information which had filtered into the press in 1946 is interesting for two reasons; it shows that the Griffon engine option was either already forgotten or just wishful thinking on the part of the designers. Secondly, the misidentified designation suggests a land-based variant may have been an option at some point, as someone had felt the need to add an "M" (for *Marine* — naval) to it.

The twin-boom configuration may have been chosen because the propeller was enclosed or "caged" within the booms, which arguably added an element of safety for carrierborne operations. The doublet of contra-rotating Chauvière four-bladed propellers was clearly expected to require some design adjustments, and in 1948 a contract was awarded to SNCASO to build a mock-up of the SO.8000 for propeller trials. Considering that in 1948 the prototypes were already under construction, it is likely that work on these trials had begun before the signing of the contract.

Other design elements developed for operation aboard carriers included the following:

- a complex flap arrangement *("hyper-sustentateurs")* with double-slotted flaps running almost the whole length of the wing's trailing edge. This was intended to lower the landing speed to 155km/h (96 m.p.h.). However, this would mean replacing the ailerons with retractable spoilers;
- folding wings outboard of the booms;
- a "kneeling" nosewheel function inspired by the USA's North American FJ-1 Fury.

Curiously, no mention is made of an arrester hook. The weight table established before the

OPPOSITE PAGE ***With its swept wings, twin booms and contra-rotating pusher propeller arrangement, the SO.8000 looked every inch the modern naval fighter when it was rolled out in 1948 — but the reality was to be quite different. This is airframe 02, actually the first to fly, with the original elevator without "ears".*** VIA TONY BUTTLER

LEFT ***Looking very much like a de Havilland Venom with a high-set tailplane, this 1946 display model shows the proposed early configuration of the SO.8000 with a distinctive compound swept wing and tip tank/pods. The model wears Aéronavale roundels and an overall white finish, standard for French Navy aircraft at that time.***

PHILIPPE RICCO COLLECTION

BELOW ***A contemporary drawing of the SO.8000 showing the powerplant arrangement and position of the pilot, and fitted with the elevator "ears" adopted after the first flight. The fairings mounted beneath the booms were intended to carry radar and radio equipment on production aircraft.***

maiden flight of the first prototype indicated that no arrester hook was fitted, suggesting that it was probably planned as standard equipment.

Several alternative armament configurations were also proposed, including 6 x 20mm cannon, each with 250 rounds, in the nose; 6 x 20mm cannon, each with 100 rounds, in the nose plus one 1,000kg (2,200lb) bomb beneath the fuselage, and 6 x 20mm guns, each with 100 rounds, in the nose plus two 500kg (1,100lb) bombs.

Another innovative feature was the provision of an ejection seat, the firing sequence of which, although never tested, involved the windscreen sliding forward to allow free passage of the pilot's legs. Forecast performance was a maximum speed of 730km/h (454 m.p.h.) at 7,500m (24,600ft) and a range of 4,500km (2,800 miles) at 530km/h (330 m.p.h.). In the latter case, extra fuel tanks would have been installed either on the wingtips (1946 design) or forward of the booms, protruding from the wing leading edge (late 1947 design). It was planned that optional protruding fairings could be used to house radar and radio equipment.

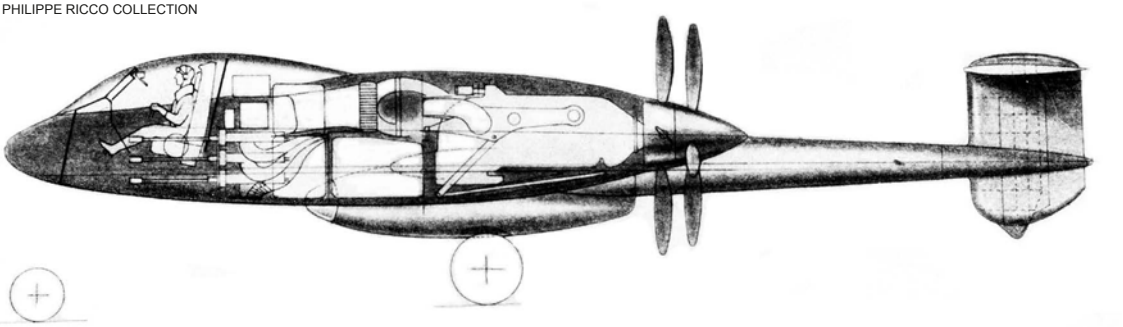
Ultimately only two examples of the SO.8000 were built, both encountering more than their fair share of troubles. The first to be completed, airframe 02, was sent from the SNCASO factory at Courbevoie, near Paris, to Orléans-Bricy, the test base for many French prototypes of the period, during the autumn of 1948.

TROUBLED TEST PROGRAMME

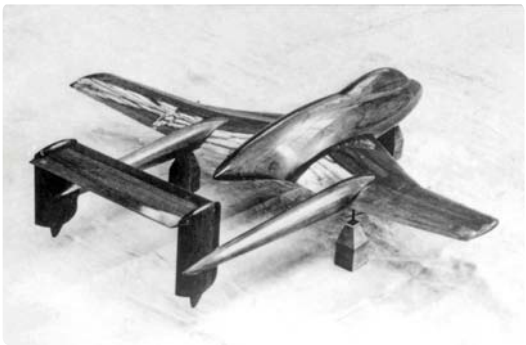
The early ground-test programme nearly cost the life of Jean Girard, SNCASO's Flight Test Director. On December 4, 1948, Girard was kneeling under the wing to monitor the engine and had put his hands in his jacket pockets to keep the December cold out. When the propellers began turning he was picked up by the airflow and thrown on to a heap of rubble, clearing the propeller disc by inches, thankfully suffering only a few broken bones.

Ground-running trials continued, but revealed a major problem; with the flaps lowered, the elevator was completely ineffective. According to some accounts, Servanty intervened and took the decision to redesign the entire empennage with a "monobloc" or slab tailplane. It should be noted, however, that this is not readily apparent on the limited number of photographs of the machine available, although the tailplane

PHILIPPE RICCO COLLECTION



"THE NARVAL, AS THE AIRCRAFT HAD BEEN NAMED, CLIMBED TO 500M AS PLANNED, AT WHICH POINT GUIGNARD ENCOUNTERED DIFFICULTY IN MAINTAINING THE MACHINE IN LEVEL FLIGHT . . ."



PHILIPPE RICCO COLLECTION

ABOVE ***The first SO.8000 to be completed was airframe 02, which is seen here shortly after its rollout, with the original tailplane configuration (contained within the fins) and radio mast fitted beneath the fuselage (later relocated to the top of the fuselage aft of the cockpit). Undercarriage doors were later fitted to this prototype, but were left off for most of the early part of the test programme.*** VIA TONY BUTTLER

LEFT ***This solid polished-wood windtunnel model of the Narval, as the type was named, has no apertures to represent air intakes, and the "bumpers" below each fin are oversized, so it was probably used for more general research into the type's aerodynamic form. It is unknown whether any of the Narval's handling problems were flagged up during windtunnel testing.***

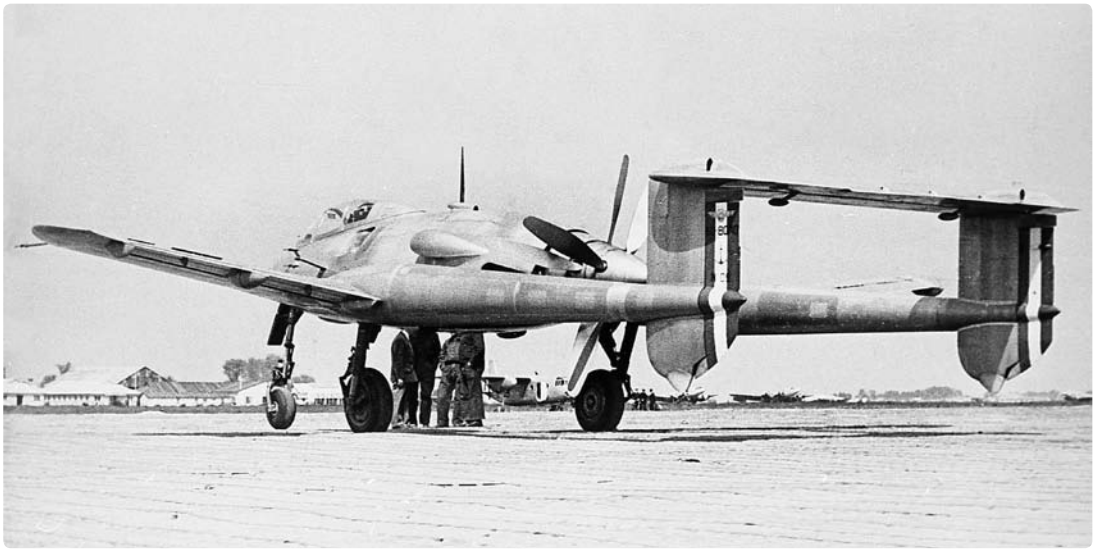
chord appears to have been increased by some 10cm (3·9in). The booms were also severed and replaced angled upwards at an incidence of 2° 15′, with metal sheets reinforcing the points at which the booms had been cut and re-attached.

After these major modifications had been implemented at Courbevoie, the aircraft returned to Bricy to resume high-speed taxying tests. Finally, after 12 high-speed runs, 02 took off on April 1, 1949, with test pilot Jacques Guignard at the controls. The weather was calm with good visibility. At 1915hr Guignard lifted the machine off the ground at 210km/h (130 m.p.h.) with the elevator trim tab set at neutral; this setting had been determined during the previous test runs — it had been originally hoped to take off at 150km/h (93 m.p.h.). The Narval (narwhal), as it had been named, climbed to 500m (1,600ft) as planned, at which point Guignard encountered difficulty in maintaining the machine in level flight. Any change in power setting induced pitch oscillations. The spoilers required delicate use and thus lateral control of the aircraft was difficult to achieve, a situation exacerbated by poor rudder authority. After 15min Guignard managed to land the aircraft but even this proved difficult, the flare being "impossible to achieve correctly".

A second flight was undertaken 20 days later after various modifications were completed, including the following :

- the addition of what was described in official flight test reports as "deflector planes" to the top of the spoilers and their setting at the correct angle; also setting the friction control of the spoilers to symmetrical;
- the span of the elevator increased beyond the fins to create "ears";
- modification of the canopy-unlocking mechanism and the addition of a safety lock to the forward-sliding windshield;
- the addition of a manometer in the cockpit to measure the powerplant's radiator pressure.

These modifications added weight, the aircraft taking off at 6,098kg (13,444lb) for its second flight, as against 6,015kg (13,260lb) on its maiden flight. Again, the weather was good when Guignard lifted the Narval off the runway



MICHEL CRISTESCU COLLECTION VIA TONY BUTTLER

ABOVE ***Following 02's maiden flight on April 1, 1949, the aircraft was substantially modified, with the addition of a larger elevator extending beyond the lateral confines of the fins, providing "ears". The tail's incidence was also altered and "deflector planes", visible on the port outer wing here, were fitted to the spoilers to improve handling.***

at Bricy at 1830hr. The undercarriage and flaps were retracted and during level flight a speed of 400km/h (249 m.p.h.) was obtained. During touch-and-goes the spoilers and elevator control were again evaluated as "weak", while rudder control was described as "correct". Oil cooling, which had proved a problem during the maiden flight, was confirmed as a major issue. Guignard landed, slightly more easily than the first time, after 35min in the air.

The third flight of 02, on April 28, was again blessed with good weather but the engine tachometer failed and the flight had to be aborted after only 15min.

PUBLIC DEBUT

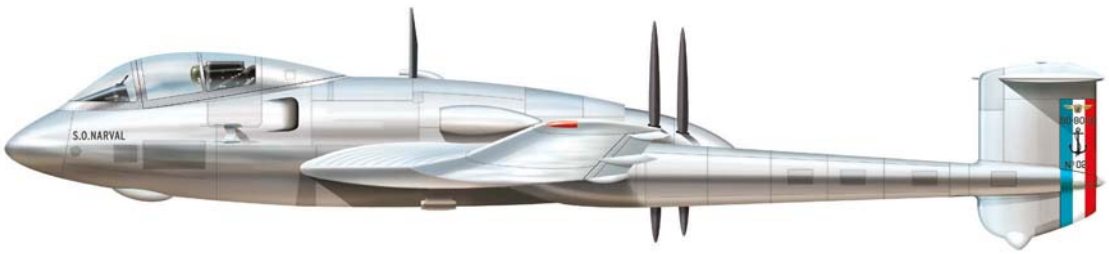
On May 12, 1949, Guignard flew 02 from Bricy to Orly, where it participated as a static exhibit at the 18th Paris Air Salon. During the aircraft's return flight to Bricy four days later, "blue fumes" filled the cockpit when the undercarriage was lowered. Guignard nevertheless managed to land the machine without causing any damage.

The test programme resumed, only to reveal further problems. The engine was overheating, owing to the cooling intakes, positioned just above the wing leading edge, being affected by a depression created by the wing, resulting in substantially reduced airflow. There was talk of relocating the intakes, but a boundary-layer trap, installed in April, appeared to help and they remained where they were. Also, the overall drag of the machine had been underestimated and it proved incapable of reaching its intended maximum speed of 730km/h (454 m.p.h.)

Flight testing continued, bringing to light a long, frustrating string of stability problems, engine trouble and other issues. On July 16, 1949, *Les Ailes* Issue No 1224 devoted a full page to the Narval. The article, which features a basic three-view general arrangement drawing and a retouched photograph representing the machine in flight, describes the project as it had originally been intended, and makes no mention of its troubled test programme. The drawing depicts a futuristic version with weapons and radar pods attached, while the text states: "In its current version, the SO.8000, to which a calculated maximum speed of 730km/h is *attributed*, is

Continued on page 84

The unarmed 02 prototype retained a bare-metal finish throughout its short career, the only markings being tricolour bars on the rudder, which also carried the SNCASO logo, Aéronavale anchor insignia and "SO.8000 No 02". Titles were also applied to the forward fuselage beneath the cockpit in at least two different typefaces. Artwork by PETE WEST © 2018



THE MEN WHO FLEW THE NARVAL

ONLY FOUR PILOTS ever flew the dreaded SO.8000 Narval — Jacques Guignard (**RIGHT**), Daniel Rastel, Roger Carpentier and Claude Dellys — all highly experienced airmen with distinguished careers in aviation. As SNCASO's chief test pilot, Rastel performed much of the Narval's ground-based testing — high-speed taxying trials and ground runs etc — but actually only flew it three times. We take a brief look at the careers of the other three.

Jacques Guignard was born in 1920 and learned to fly shortly before the outbreak of the Second World War. Guignard sailed to England following the fall of France in the spring of 1940. Having completed his training with the RAF, Guignard was posted to No 32 Sqn, with which he flew Hawker Hurricanes. During the war Guignard achieved three aerial victories. On his return to France in early 1945 he volunteered to become a test pilot and was sent back to the UK for instruction at the Empire Test Pilots School at Boscombe Down, where he became only the second French pilot to fly a jet aircraft — a Gloster Meteor — on August 9, 1945. Guignard subsequently received the first test pilot's licence to be awarded in France after the war, and went on to become France's leading test pilot, flying many of the nation's ambitious post-war designs, including the rocket-powered SNCASO SO.9000 Trident II and the Anglo-French BAC/Aérospatiale Concorde.

Roger Carpentier Born in Paris on January 17, 1921, Roger Carpentier became a military pilot and took part in the Battle of France, flying with fighter unit *Groupe de Chasse 1/2*. He joined the *Forces Françaises Libres* (Free French forces) after Operation *Torch* (the Allied invasion of French North Africa in 1942) and was transferred to the UK. After the war he flew operations in French Indochina (now Vietnam) after returning to GC 1/2, by this time named *Cigognes*. By 1948 Carpentier had joined the team of test pilots attached to the *Centre d'Essais en Vol* (CEV — Flight Test Centre) at Brétigny, where he had the opportunity to fly the Narval. In 1955 Carpentier was appointed chief test pilot at Sud Aviation. Tragically, Carpentier was killed while testing the Sud-Est SE.116 Voltigeur twin-engined ground-attack aircraft on January 9, 1959. Carpentier's career honours include the *Croix de Guerre* 1939–45 & TOE (overseas operations) and *Commandeur de la Légion d'Honneur.*

Claude Dellys Born in Paris on October 12, 1912, Claude Dellys found his original calling was to become a priest; but he turned his devotion to aviation, and in 1938 became a flying instructor at the *Ecole de l'Air* in Salon de Provence. While there Dellys became one of the few pilots selected to join the formation aerobatic team *Patrouille d'Etampes* (forerunner of the post-war *Patrouille de France*). Following the fall of France in 1940 Dellys flew fighters in North Africa for the Free French before joining the Free French civil air service (SCLA), also in North Africa. On his return to France he became a *maquisard* — resistance fighter — until the country's liberation. In 1946 Dellys returned to full-time aviation to become a test pilot. On February 21, 1952, Dellys was ferrying the second prototype Arsenal VG 90 from Melun-Villaroche to the CEV at Istres when flutter caused the tailplane to fail; Dellys tried to eject but the Martin-Baker ejection seat malfunctioned and he was killed. He was made a *Chevalier de la Légion d'Honneur* for his contribution to the development of French aviation. **JCC**

LEFT ***Roger Carpentier learned to fly at the Ecole de l'Air in 1939 and qualified in 1940, aged 19. In May 1958 he set a new world altitude record — 24,217m (79,450ft) — in the SNCASO Trident II.***

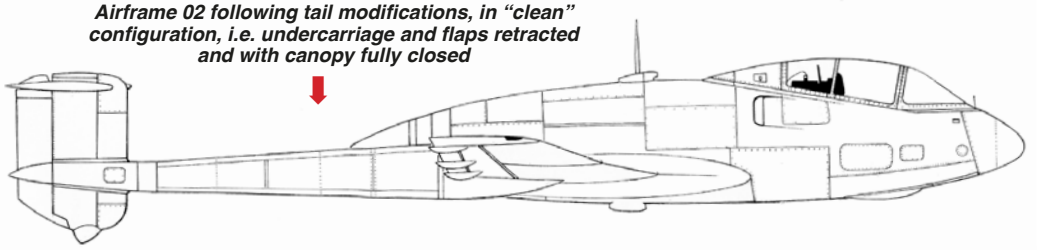
RIGHT ***Claude Dellys learned to fly in 1932 and later flew Curtiss Hawk 75s for the Free French in North Africa, before becoming a renowned resistance fighter in France.***

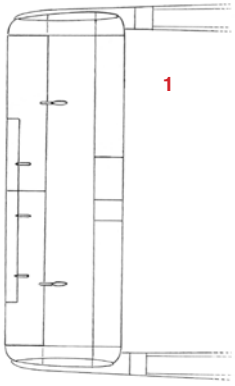
SNCASO SO.8000 NARVAL

Artwork by JOËL MESNARD © 2018

Although of unusual configuration, the SO.8000 Narval was essentially of conventional all-metal construction, fitted with wings incorporating double-slotted retractable Fowler-type flaps, lateral control being effected by means of spoilers and, on 01, small ailerons

Airframe 02 following tail modifications, in "clean" configuration, i.e. undercarriage and flaps retracted and with canopy fully closed



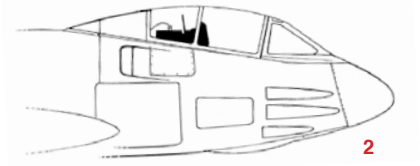


1

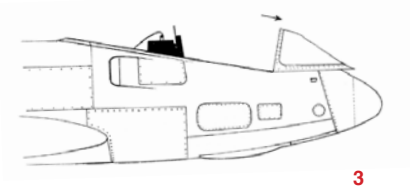
1 *Plan view of the tail of 02 before modification, with standard elevators and horn balances, as per its first flight on April 1, 1949*

2 *Nose detail of airframe 01, showing armoured windscreen and six-gun installation (without guns fitted); the air intake beneath the cockpit was revised during the test programme*

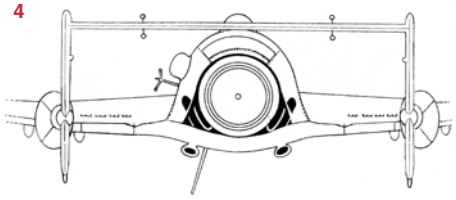
3 *The windscreen portion of the canopy was intended to slide forward as part of the ejection sequence to allow free passage of the pilot's legs*



2



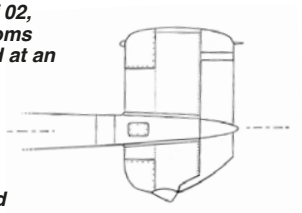
3



4

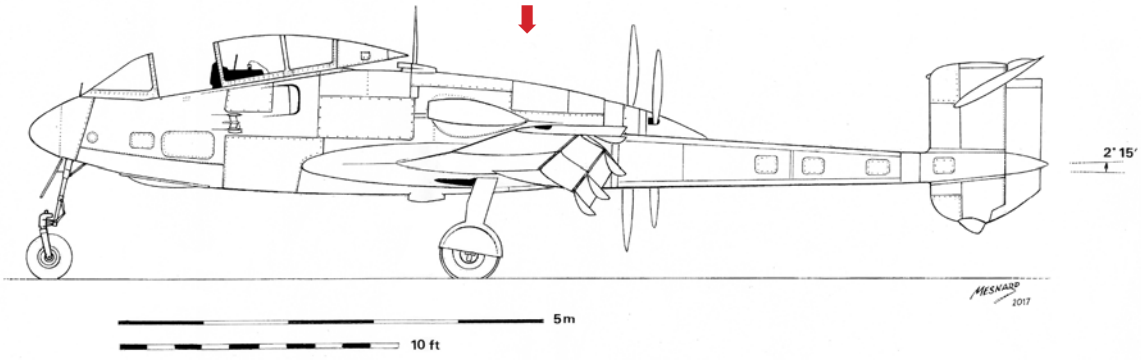
4 *Rear view of 02 as it first flew, before an enlarged elevator of greater span was fitted, creating "ears", i.e. the elevator extended beyond the fins*

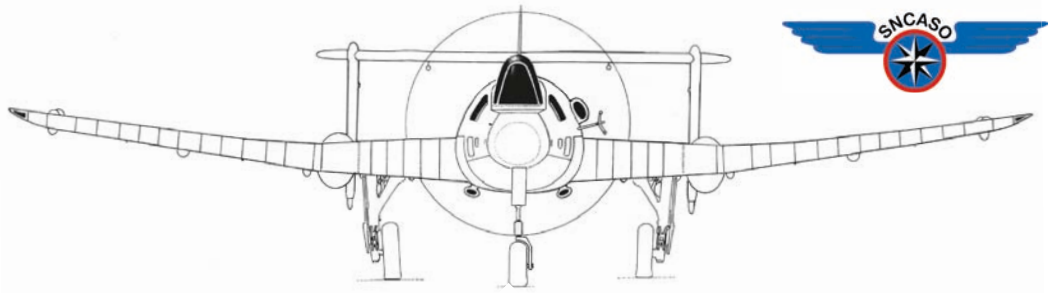
5 *Detail of the port tail unit of 02, before the aft ends of the booms were severed and re-attached at an increased incidence of 2° 15'*

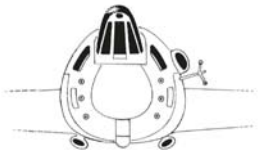


5

Port view of 02 with canopy open, undercarriage and flaps down, and with revised tail unit with larger elevator (including "ears") and modified booms canted upwards. The radio mast was initially fitted to the underside (as in view 4) but was relocated behind the cockpit during the test programme





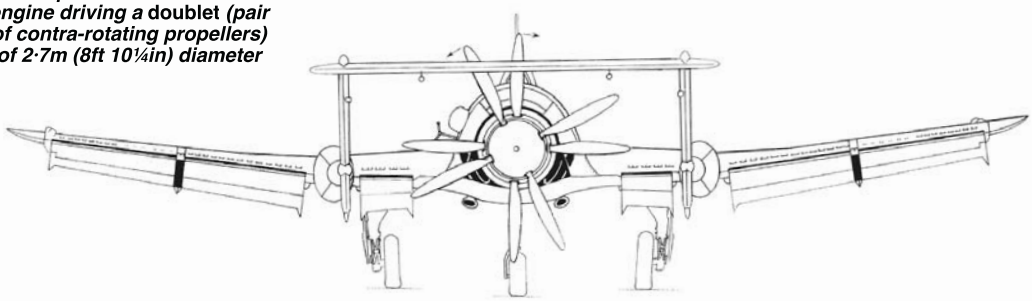


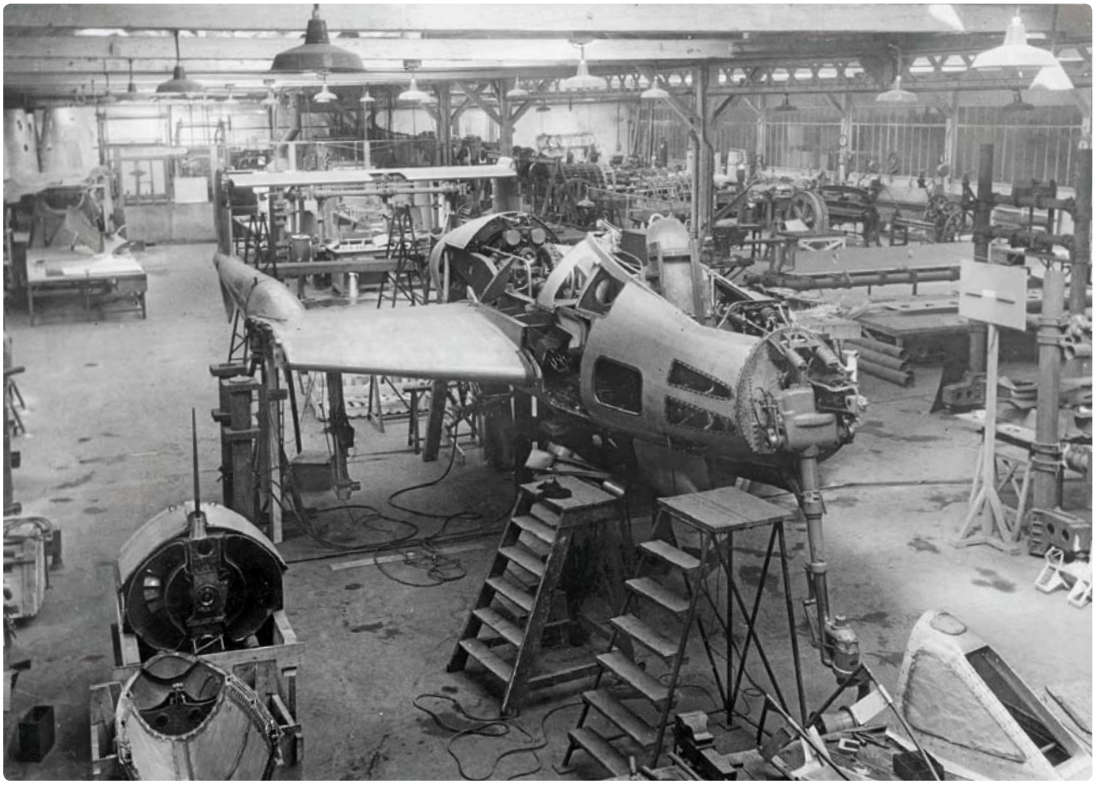
6

6 ***Only 01 was fitted with the six-gun installation and an armoured windscreen and forward canopy section, as seen in these details. Note the pitot tube attached to an outrigger on the port side of the forward fuselage***

The plan, frontal and rear views presented here show 02 after its tailplane modifications. The SO.8000's wing was cranked with its leading edge swept at an angle of 24° to a point outboard of the booms, with the outer sections swept at 13·5°

The SO.8000 was fitted with a single 2,220 h.p. Arsenal 12H liquid-cooled V12 inline engine driving a **doublet** ***(pair of contra-rotating propellers) of 2·7m (8ft 10¼in) diameter***





PHILIPPE RICCO COLLECTION

ABOVE ***Very few photographs of airframe 01 appear to exist, this example showing the aircraft under construction at Courbevoie. Note the gun troughs located in the forward fuselage; only 01 was fitted with these, along with the armoured windscreen and forward canopy section, seen here on the floor to the right of the nosewheel leg.***

Continued from page 80

naturally less speedy than its competitors fitted with a Nene [jet]". (The author has added italics to emphasise how the article dissociated itself from the documentation which SNCASO would have provided.)

Meanwhile, the flying prototype's sister aircraft, 01, was still under construction, and it was decided to incorporate some of the modifications required to remedy the problems found with 02. From the outset it included a major difference: the flaps were reduced in length and conventional ailerons were installed.

Transferred to the *Centre d'Essais en Vol* (CEV) at Brétigny, 02 was flown by test pilot Roger Carpentier on December 9, 1949, and again on the 16th and 21st. Carpentier's report for the CEV was damning. The aircraft's overall performance was deemed unsatisfactory for a combat aircraft and the pilot's workload was deemed to be too heavy to make it viable for anything but flights of short duration. The overall instability of the aircraft made it a poor weapons platform and, importantly, hampered its suitability for carrierborne operations.

Furthermore, visibility forward was poor owing to the rounded canopy of 02, although the armoured canopy of 01, with its three panes, would have been an improvement. Changes in power settings induced a downward pitching moment, putting the aircraft into a dive which the pilot found difficult to counter.

ENTER 01

The second prototype, 01, finally flew from Bricy on December 30, 1949, in the hands of Guignard. It differed from 02 in that it was configured as an armed machine, fitted with weapons, ammunition, armoured panels and full avionics including an IFF (identification friend or foe) system, but with no sighting device, no arrester hook and no motor for the wing-folding mechanism. The propeller spinner was also not installed, and neither were the undercarriage doors. The machine weighed in at 6,581kg (14,509lb) for the maiden flight.

At 1030hr the aircraft took off, leaving the runway after a 1,000m (3,300ft) run at a speed of about 210 km/h (130 m.p.h.). Retracting the undercarriage required two cycles, as the starboard mainwheel did not lock initially. The flaps were retracted at 600m (2,000ft), resulting in the aircraft "leaning to the right" ("*pencher à droite*" in Guignard's phrase). As a result, he elected to fly with the flaps half-down, and levelled out at 1,100m (3,600ft), before landing at 1100hr. Guignard reported weak reactions to the controls but assessed the engine temperature as "correct".

THE SNCASO SO.8000 NARVAL FLIGHT TEST PROGRAMME

The two SO.8000 prototypes, 01 and 02, made a total of 46 flights during the type's short career, with 44 by the first to fly, 02, and only two by 01. Four pilots flew the type; Jacques Guignard (JG), Daniel Rastel (DR), Roger Carpentier (RC) and Claude Dellys (CD). The duration of each test flight is shown below, where known.

Date	Aircraft/ Flight No	Duration (min)	Comments	Pilot
1949				
April 1	02-1	15	First flight	JG
April 21	02-2	35	Undercarriage retracted for the first time	JG
April 28	02-3	15	Flight cut short owing to instrumentation problems	JG
May 12	02-4	25	Ferry flight to Orly for static exhibit during Paris Air Salon	JG
May 16	02-5	25	Return to Bricy test base from Orly. Engine radiator leaking	JG
May 24	02-6	—	500km/h (311 m.p.h.) reached	JG
June 9	02-7	70	Longitudinal stability tests	JG
June 11	02-8	—	Longitudinal stability tests	JG
June 15	02-9	55	Stalling speed tests	JG
July 10	02-10	10	—	JG
July 17	02-11	—	Engine cooling tests	JG
July 20	02-12	—	Engine cooling plus stalling speed tests	JG
July 21	02-13	—	Engine cooling plus stalling speed tests	JG
July 23	02-14	35	Ditto; 8hr 30min total flight hours logged by this point	JG
July 27	02-15	—	—	JG
July 27	02-16	35	—	JG
July 28	02-17	45	Stability tests	JG
July 29	02-18	40	Stalling tests	JG
July 30	02-19	—	—	JG
August 6	02-20	10	Aborted owing to propeller regulator failure	JG
August 30	02-21	10	General test after modifications made during the month	JG
September 1	02-22	—	Stalling speed test	JG
September 2	02-23	—	Stalling speed test	JG
September 3	02-24	—	Stalling speed test	JG
September 7	02-25	—	Aborted owing to engine issues	JG
October 3	02-26	25	General test after engine change	JG
October 11	02-27	—	Test pilot Daniel Rastel's first flight in SO.8000	DR
October 14	02-28	25	Flight shortened owing to tachometer failure	JG
October 22	02-29	—	Propeller malfunction	JG
October 27	02-30	80	Flight duration record for the type	DR
October 28	02-31	—	—	DR
November 3	02-32	—	—	JG
November 10	02-33	40?	Ferry flight to CEV at Brétigny	JG
November 10	02-33	40?	Return to Bricy	JG
November 13	02-34	—	General testing	JG
November 19	02-35	—	General testing	JG
December 5	02-36	—	Propeller test	JG
December ?	02-37	40?	Ferry flight to Brétigny	JG
December 9	02-38	—	First flight by Roger Carpentier, CEV; aborted owing to instability issues	RC
December 9	02-39	—	Control flight by Jacques Guignard, who confirms the instability and claims that "he has got used to it"	JG
December 16	02-40	45	General handling evaluation	RC
December 21	02-41	—	General handling evaluation	RC
December 30	01-1	—	First flight of airframe "01"	JG
December 30	02-42	40	First flight by Claude Dellys; return to Bricy	CD
1950				
January 6	02-43	70	Engine and flying controls tests	CD
January 8	01-2	—	General testing	CD
January 9	02-44	25	Final flight of "02" and the type	CD

SOURCES

The information contained in this article has been gathered from multiple sources, including *Les avions de combat français 1944–1960* by Jean Cuny, Docavia, 1989; *Vols d'essais le centre d'essais en vol de 1945 à 1960* by Jean-Claude Fayer, E.T.A.I., 2001; *Le Fana de l'Aviation* Issues No 180–181, article by Pierre Gaillard and Alain Marchand; *Le Moniteur de l'Aéronautique* Issue No 19, article by Joël Mesnard; *Les Ailes* Issue No 1224, article by André Frachet; *La Revue Aéronautique*, various articles; flight test reports by Jacques Guignard

Airframe 02 at an unknown location after its various modifications, including the resetting of the empennage at an increased negative incidence and the addition of a supplementary vane in the air intake to solve airflow problems. Note also the stylised "Narval" legend on the forward fuselage, later changed to simpler block lettering reading "S.O. Narval".

VIA TONY BUTTLER

VIA TONY BUTTLER

ABOVE *Airframe 02 was given the French civil registration F-WFKV (the F-W--- sequence being reserved for test aircraft and delivery flights), probably late in its short career. It is seen here taxying out for a flight, by this time with mainwheel undercarriage doors fitted and with the one-piece extended elevator deflected fully upwards.*

PHILIPPE RICCO COLLECTION

ABOVE *An extremely rare photograph of both Narval airframes together, albeit during scrapping, with the gun troughs on the right-hand example marking it as 01, with its armoured windcreen on the ground alongside. The Aéronavale ultimately replaced its Dauntlesses with more American types — the F6F Hellcat and Curtiss Helldiver.*

SNCASO SO.8000 NARVAL DATA

	July 1946 original design (unbuilt)	December 1947 revised design (unbuilt)	As built and flown
Dimensions			
Span	—	11·77m (38ft 7¾in)	11·70m (38ft 5in)
(with tiptanks)	11·70m (38ft 5in)	—	—
Length	11·57m (37ft 11½in)	11·83m (38ft 8in)	11·57m (37ft 11½in)
Wing area	26m² (280ft²)	26·3m²* (283ft²)	26·3m²* (283ft²)
Weights			
Empty	3,788kg (8,351lb)	4,821kg (10,628lb)	—
Max take-off			
Fighter	5,816kg (12,822lb)	6,606kg (14,564lb)	—
Fighter-bomber	6,339kg (13,975lb)	6,606kg (14,564lb)	—
Rocket-strike	6,036kg (13,307lb)	7,261kg (16,008lb)	—
Typical ferry	6,339kg (13,975lb)	6,926kg (15,269lb)	—
01 actual			6,581kg (14,509lb)
02 actual			6,350kg (14,000lb)
Performance			
Maximum speed			
(estimated)	730km/h at 8,500m (454 m.p.h. at 27,900ft)	730km/h at 8,500m** (454 m.p.h. at 27,900ft)	—
02 actual			560km/h at 5,800m (348 m.p.h. at 19,000ft)
Landing speed			
(estimated)	155km/h (96 m.p.h.)	150km/h*** (93 m.p.h.)	—
Stalling speed	—	—	
02 actual			200km/h (124 m.p.h.)†
Range			
Operational			
(estimated)	1,000km (620 miles)	1,000km (620 miles)	—
Ferry (estimated)	4,500km (2,795 miles)	4,500km (2,795 miles)	—

* *Les Ailes* states 26·5m² (285ft²) ** *Les Ailes* states 730km/h at 7,500m (454 m.p.h. at 24,600ft)
*** *Les Ailes* states 155km/h (96 m.p.h.) † This was more often nearer 250km/h (155 m.p.h.)

This final prototype flew only once more, on January 8, 1950, with Claude Dellys at the controls. The undercarriage doors were reported as being fitted, but whether the propeller spinner was fitted remains unclear. Dellys took off at 1100hr, retracting the undercarriage with no problems, although retracting the flaps again provoked a "leaning to the right" (presumably banking to starboard), which Dellys compensated for with either a bit of left boot on the rudder pedal or by resetting the trim control. Dellys felt that rudder authority could still be improved. The flaps were again set in a middle position during the flight and the aircraft landed in this configuration 30min after take-off.

Dellys reported having difficulties during touchdown, as had Guignard during his flights in 02. The subsequent flight report mentions that the undercarriage doors remained open after lowering the mainwheels, which suggests that they should have closed again once the mainwheels were extended.

On January 9 Dellys was given the dubious honour of making the last flight of the type in 02, a flight which lasted only 25min. Dellys' flight report merely confirmed what his colleagues had already concluded: the Narval was difficult to fly accurately and could become downright dangerous during landing.

The arrival of 01 and its subsequent flights came too late to convince anybody to continue with the programme, and both machines were scrapped. It may have looked futuristic, but it was quickly consigned to history.

ACKNOWLEDGMENTS *The author and Editor would like to thank Philippe Ricco, Joël Mesnard, Tony Buttler and Gill Richardson at Crécy Publishing Ltd for their invaluable help with the preparation of this article*

748 into AFRICA

In November 1969 Skyways Coach-Air Hawker Siddeley 748 pilot **BRIAN TURPIN** was seconded to the manufacturer to share flying duties of the company demonstrator during a sales expedition to Africa. He relates how the rugged and dependable turboprop excelled on its tour of some of the big continent's most remote airstrips

AT THE END of October 1968 British independent airline Skyways Coach-Air was awarded a contract to provide an aircraft and crew on long-term lease to the Ford Motor Company, to assist in providing regular air travel for its employees between the various manufacturing sites of the company in Europe. The Ford Air Transportation Department (aka Fordair) was formed at Stansted in 1967 and began regular air services in August of that year using a single 18-seat Grumman Gulfstream I. It soon became apparent that much more capacity was required and that, in addition to acquiring a second Gulfstream, the company would have to lease a suitable aircraft from an airline. Skyways was contracted to provide one 48-seat Hawker Siddeley 748, the aircraft to be operated out of Stansted from Monday to Friday. An experimental service was to be provided for two weeks during November 1968, the results of which would determine whether the contract would be signed for an extended period.

As a result, I found myself on the evening of November 4, 1968, positioning 748 G-ARMX to Stansted with Capt George Pewtress, to be ready for the first service on the afternoon of the 5th. It proved to be the first of many such positioning flights and for me an association with Fordair which was to last for

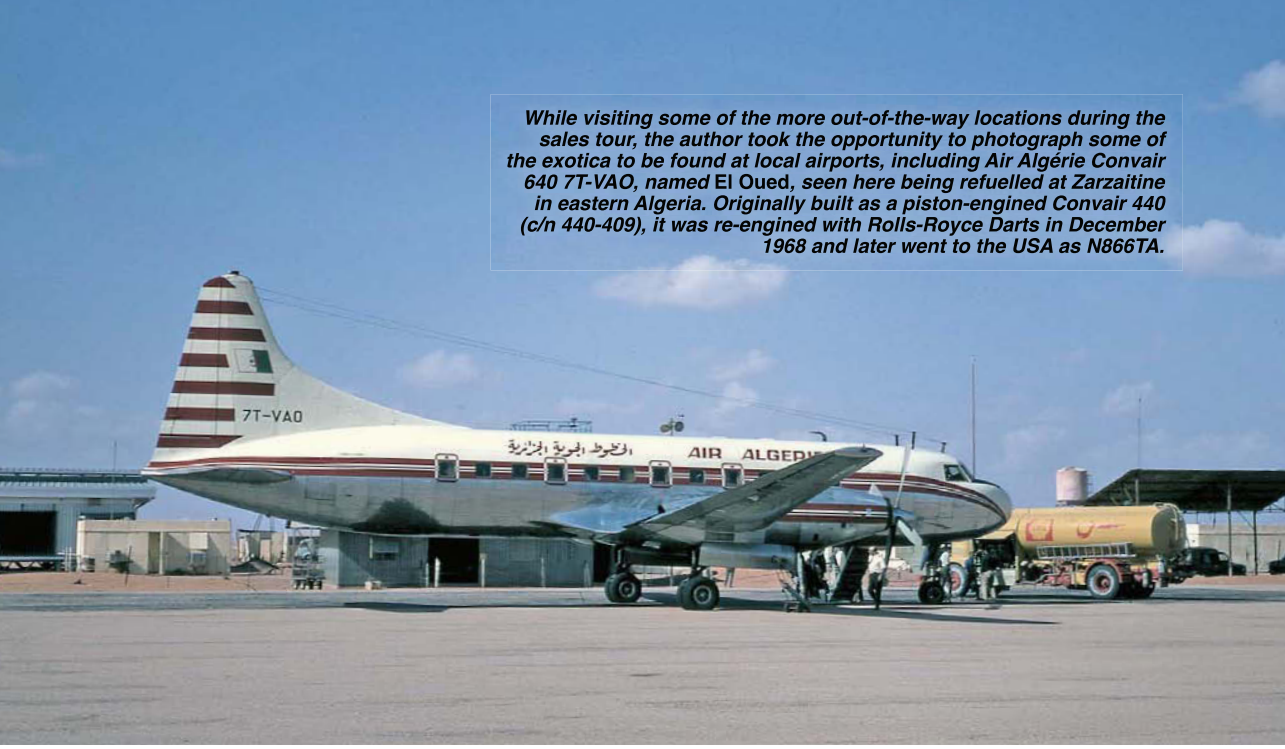
RIGHT *One of the more remote airfields visited by 748 demonstrator G-AVRR during the 1969 sales tour of Africa was Yagoua in far northern Cameroon. The 5,340ft (1,630m) north-east/south-west grass runway was largely dust and scrub during the author's comparatively few visits to the airfield.*

ALL PHOTOGRAPHS VIA AUTHOR

INSET LEFT *The author in the right-hand seat of a 748 while working for Skyways Coach-Air, as covered in* Further Out on a Lympne*, an article based on his recollections of flying the type for the company, published in* TAH19.

BELOW *With the Outeniqua Mountains rising majestically in the background, 748 Series 2A c/n 1635 — by this time wearing South African civil registration ZS-IGI in order to satisfy local legal requirements — awaits its next flight at George, on South Africa's Western Cape, in December 1969.*


WKER SIDDELEY 748
ZS-IGI



While visiting some of the more out-of-the-way locations during the sales tour, the author took the opportunity to photograph some of the exotica to be found at local airports, including Air Algérie Convair 640 7T-VAO, named* El Oued*, seen here being refuelled at Zarzaitine in eastern Algeria. Originally built as a piston-engined Convair 440 (c/n 440-409), it was re-engined with Rolls-Royce Darts in December 1968 and later went to the USA as N866TA.

nearly 30 years. The service consisted generally of round trips to Cologne with the occasional night stop there as the schedule required. The experiment was a success, regular scheduled services beginning in January 1969 and continuing until January 1971.

The usual trip time was 1hr 50min, which gave the cabin crew ample time to provide the high standard of in-flight food and drink services required. One of the problems for the flightdeck crew on the early Series 1 748s was the lack of adequate cockpit heating. Whereas in the Douglas DC-3 the flightdeck could be turned into an oven while the passengers froze, the 748 was the exact opposite. *[See the author's recollections of flying the DC-3 for Skyways Coach-Air,* Out On a Lympne*, in TAH17 — Ed.]* Consequently, on these longish flights to Cologne in midwinter we tended to suffer from the cold conditions. This was particularly true of the feet. One of our pilots experienced pain in his toes and noticed that they were turning a delicate shade of blue. His doctor confirmed that he was suffering from mild frostbite. Having reported this to the company, we were all given £5 to go out and buy ourselves flying boots!

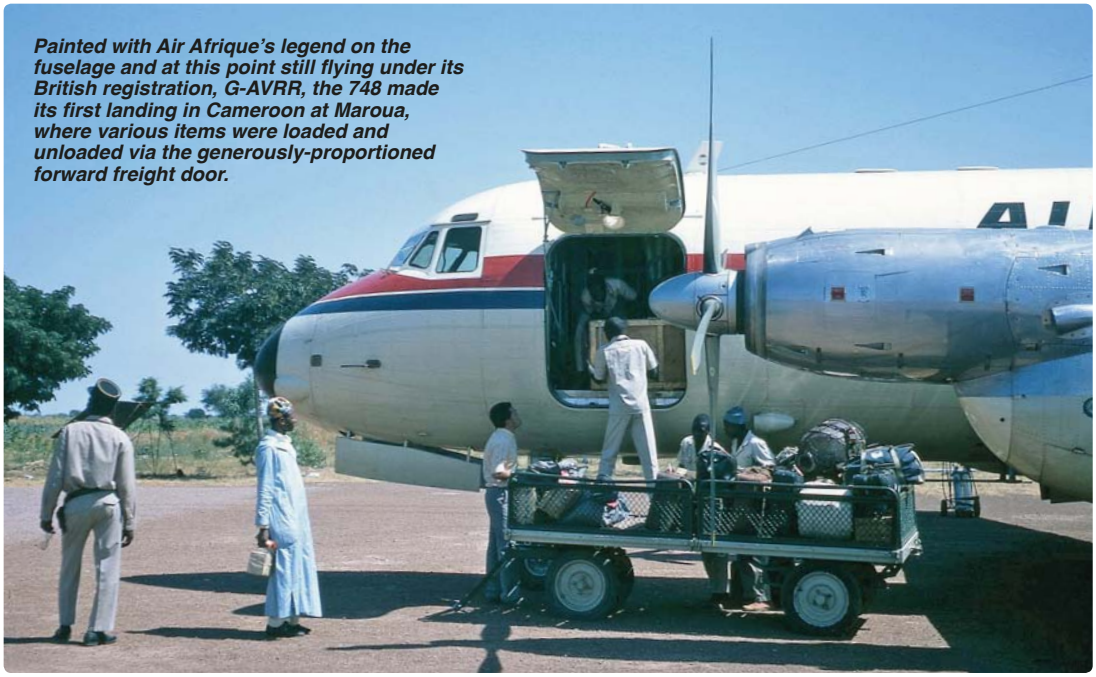
TO THE BIG CONTINENT

In January 1970 Skyways bought a new 748 Series 2, G-AXVG, which was dedicated to the Ford operation, with a special 40-seat configuration. It was based full-time at Stansted, the operating flight crew positioning up from Lympne on interminable taxi rides on Sunday evenings, returning home the following Friday. The new aircraft, with its uprated Dart engines, offered a slightly faster service, higher payload, improved avionics and its own wonderful set of Heath-Robinson-style retracting airstairs for the rear cabin door.

In October 1969 I was asked if I would like to be seconded to Hawker Siddeley Aviation (HSA) to take part in a 748 sales tour of Africa. Of course I readily agreed. The tour was to begin in Cameroon, West Africa, with a series of scheduled flights over a period of one month for Air Afrique. This was to be followed by demonstration flights in South Africa which were to last until Christmas. The close association between HSA and Skyways, which had existed since the inception of the 748, had resulted in the company's pilots being used to train aircrew of other airlines converting to the new aircraft. My secondment was an extension of this relationship.

At the beginning of November I travelled up to Woodford to meet the crew with which I was to fly. The captain was to be Harry Fisher, an ex-RAF Avro Shackleton pilot who was now working for HSA as a production test pilot. We were to be ably supported by Bob Dixon-Stubbs in the dual role of navigator and operations manager. We also had a sales team under the direction of Senior Sales Engineer John Howarth, and, most importantly, three very valuable engineers who did sterling work throughout the trip in keeping the aeroplane flying; Frank Lord, Albert Jones and Alan Offer.

The aircraft in question was 748 Series 2a G-AVRR, my first flight in the aircraft taking place on November 6, when I flew as copilot to Jimmy Harrison, HSA's chief test pilot for



Painted with Air Afrique's legend on the fuselage and at this point still flying under its British registration, G-AVRR, the 748 made its first landing in Cameroon at Maroua, where various items were loaded and unloaded via the generously-proportioned forward freight door.

the 748. This was to be the aircraft's Certificate of Airworthiness (CoA) test flight, but I was conscious of the fact that it was also a test of my ability. The flight lasted an hour, ending in a low single-engined flypast at Woodford for the benefit of the company's photographer. At this point Jimmy handed the aircraft over to me to complete a single-engined circuit and landing, which I am glad to say I managed to accomplish without bending anything.

The next few days were spent making final preparations for the trip. We finally departed Woodford at 1235hr on November 10, our destination being Cagliari, in Sardinia, where we arrived in the dark after a flight of 4hr 35min. After a night stop at the Hotel Mediterranean, we set off at 0830hr the next morning via airway Amber 9C, passing Tunis, Djerba and Ghadames to Zarzaitine in Algeria for a refuelling stop. This airfield in the desert, close to the Libyan border, was there primarily to serve the local oilfields.

Unfortunately, the port outer mainwheel tyre burst on landing, which seriously delayed our departure as well as using up a valuable spare wheel. We were told that the maximum day temperatures reached 42°C (108°F) and the minimum night temperature fell as low as -10°C (14°F); so there was some concern about us being delayed, as the high daytime temperatures could seriously affect the amount of fuel we could uplift for the next sector.

ACROSS THE SAHARA

We eventually got away at 1515hr, well behind schedule for the next leg of our journey across the Sahara and Lake Chad to our final destination of the day, Fort Lamy, the Chadian capital (now N'Djamena). Darkness fell as we continued on our way at Flight Level 170 (17,000ft/5,200m) across endless miles of sand dunes until at last, largely thanks to the navigational skills of Bob Dixon-Stubbs, we arrived at Fort Lamy. This sector of 1,020 miles (1,640km) was flown in 4hr 45min, off airways and for the most part without the benefit of radio navigational aids. We were all very glad to stagger into the Hotel Tchadien for a meal and a good night's rest.

Fort Lamy was an old French military town, still with more than a touch of the "Beau Geste" about it with its large military forces, particularly air force, very much in evidence owing to the then-recent unrest in Chad. Situated on the confluence of the Chari and Logone rivers which flow northward into Lake Chad, it was an important cattle market and trading centre. The climate was hot but dry and not unpleasant, particularly in the early mornings when we usually left for our first service of the day.

The following morning we met up with Capt Bourice, chief pilot of Air Afrique, who was to fly with us that day down the route through Cameroon. He usually flew Sud Caravelles. Our departure was delayed for a few hours while confirmation was obtained of our permission to fly through the country. We finally departed at 1030hr and flew direct to Maroua, which, like most of the Cameroon airfields we operated into, had no paved runway — just hard earth (laterite), much used for road-making in Africa, rolled into a long smooth strip — with a cluster of airport buildings to one side.

ABOVE ***The pilot's-eye-view of the 1,390ft (420m) laterite runway at Maroua in northern Cameroon. The 748, originally an Avro design, had been conceived from the outset as a rugged DC-3 replacement capable of operating from semi-prepared strips in "hot and high" conditions, so the type was in its element on the African sales tour.***

The airport manager kept a fly-blown and sad-looking lion and a cheetah in cages at the back of one of the buildings. There were also a number of ostriches and peacocks wandering about. The surrounding country was open grassland with some hills and rocky outcrops. The weather was hot but still with low humidity.

Next stop was Yagoua, a small airfield with a sandy earth and grass runway, surrounded by small groups of round mud huts, each group circled by a low mud wall. All the villagers turned out to see the aeroplane arrive, but we only landed and then took off again straight away. This was the most remote of the "up-country" airfields and we made very few visits there during our month's tour of duty.

We then proceeded to Garoua, which had a long east–west paved runway with a hump in the middle. This became our main refuelling stop on the route, as pressure-refuelling was available. Some days later, when we were landing here at dusk on a scheduled service, we noticed that the runway lights kept going off at intervals during our approach. After landing, we asked the air traffic controller the reason for this and he said that he only had limited electrical power and there was not enough for both the runway lights and the radio at the same time. Whenever he wanted to speak to us on the radio he had to turn the lights off!

The next stop, N'Gaoundéré, was not so well equipped, the runway again being laterite, and refuelling was over-wing out of drums using a hand pump. We uplifted 200lb (90kg) of fuel, just to test the system. The locals thought we were mad taking such a small amount but we wanted to avoid using this method as much as possible, particularly on the regular services, as it is a very slow process and we were not too sure of the quality of the fuel.

We then moved on to Batouri, another remote spot with a rough runway surface and long grass. There was a small airport building and little else. The VHF radio was carried in the back of a Land Rover owned by the airport manager. We landed, turned round and took off again immediately. We overflew Yaoundé, the capital of Cameroon, as we knew it was a well-equipped airfield with full navigational aids and a long paved runway. We were now heading for our final destination, Douala on the west coast, which we reached at 1725hr after a busy day.

The climate in Douala is hot and very humid. The old French colonial town is surrounded by forest, which grows right down to the shoreline. The area around the town is a maze of rivers and inlets with all the land covered by trees and bushes, broken only by occasional groups of huts at the water's edge, which form isolated villages to which the only access is by water.

Douala itself was rather run down, with most of the colonial-style buildings in need of repair and with rough roads and broken-up pavements. We stayed initially in the Akwa Palace Hotel, situated on the main street, which in its day must have been rather grand, but which now had little to recommend it. Feeling the heat and the lack of air conditioning, we soon moved to the Hotel Des Cocotiers, which, having a swimming pool, somewhere to sit in the sun — not to mention a cool bar — was more acceptable in the hours when we were not flying. Generally speaking, there was little to see or do in Douala, which is the main port of Cameroon

MAP BY MAGGIE NELSON

One of the 748's rare visits to Yagoua in northern Cameroon, with the locals taking a keen interest in the aircraft. Having made its maiden flight on September 5, 1967, G-AVRR was used extensively by the manufacturer for trials and demonstration duties throughout 1968, during which it paid visits to numerous countries including Eritrea, Egypt, Italy, France, Cyprus, the USA and Canada.

Another item of interest photographed along the way was the Cameroonian Presidential Convair 440 TJ-AAD (c/n 440-439), which still retained its Pratt & Whitney Double Wasp piston engines. It was acquired by the Cameroonian government in September 1963 and later saw service with Belgian airline Delta Air Transport as OO-VGJ from 1974 and American Airlines Inter-Island as N44829. It remains on the "active" list in 2018 as XA-TFZ with Mexican airline Aero Cedros.

and is therefore mainly commercial. Its saving grace was the fine French cuisine — and that cool bar, of course.

TO THE CAPITAL

After a day off we demonstrated the aircraft to Air Afrique pilots on November 14, and in the afternoon flew to Yaoundé with the sales team for further demonstration flights. These were for the French *Armée de l'Air* pilot who flew the Cameroonian Presidential aircraft, a Convair 440, followed by the Chief of the *Armée de l'Air du Cameroun* (AAC — Cameroonian Air Force). At the time the AAC was equipped with Douglas C-47s, Nord Noratlases, Dassault Flamants and Max Holste Broussards. Yaoundé Airport had one runway, perched on top of a hill with built-up extensions at either end. The approaches were good but there was a lot of high ground to the west. There was a non-directional beacon (NDB) and a VOR beacon on the airfield, the latter being useful in the early mornings when the forest was often shrouded in mist. The airport buildings were clean, new and spacious, as befitted the capital city. We returned to Douala that night.

The following day, Saturday the 15th, we began our roster of regular scheduled services. The crew consisted of Harry Fisher and myself; Bob Dixon-Stubbs; an Air Afrique pilot; an operations man, M Lapuqade, who flew with us on most services; a steward, and one of our engineers, Frank Lord, on the first rotation.

The first day was easy, just a 50min flight from Douala to Yaoundé, but the following day was more typical. Starting at 0605hr local, we flew the route up-country via N'Gaoundéré, Garoua and Maroua to night stop at Fort Lamy. On the following day, with another early start, we flew back down to Douala, taking in Yagoua and Batouri as well — a seven-sector day.

Apart from a few days when we simply operated a rotation between Douala and Yaoundé, this set the pattern for the rest of our stay in Cameroon. Up-country one day and down the next, carrying an assortment of passengers, their baggage, chickens, goats, beds and anything else which could be manhandled through the 748's generous forward freight door. The country varied from rainforest around Douala and Yaoundé, rising northwards to the Adamawa Plateau in the area around

***A very welcome diversion at Yaoundé was Boeing B-17G F-BEEA of the French* Institut Géographique National (IGN), *which was engaged on aerial survey work at the time. The aircraft, originally built as 44-85643, was operated by the IGN during 1947–89. Sadly, it was destroyed in a non-fatal take-off accident at RAF Binbrook in the UK during the filming of the 1989 film* Memphis Belle.**

One of the regular stops on the Cameroonian routes flown by the 748 team during the November–December 1969 sales tour was Batouri, which, as seen here, offered rather primitive facilities, but which presented as few problems for the aircraft as the other "up-country" airfields it visited during the West African leg of the expedition.

N'Gaoundéré, before sloping gradually down towards Lake Chad. The region between Garoua and Fort Lamy was savannah country, supporting elephants, lions and leopards.

Navigation was mainly via NDBs located at most of the airfields we visited, with VORs at Douala and Yaoundé. The former also had an instrument landing system (ILS). Communication was via rather erratic HF with Brazzaville in the Republic of the Congo en route and VHF with the local control towers. Being the dry season, the weather was generally good with occasional heavy thunderstorms, and we only had to make one VOR approach to Yaoundé during the whole period. The contract finished on December 5, by which time we had flown 92 hours in 18 days, an average of 5hr per day.

FURTHER SOUTH FOR THE WINTER

After a much-needed day off, and having said our goodbyes, we departed Douala at 0800hr for the first stage of our journey to South Africa, a 3½hr flight to Kinshasa in the Democratic Republic of the Congo (previously Congo-Léopoldville). The flight took us over miles of sparsely populated countryside and forest, across Gabon and Congo-Brazzaville, crossing the Equator at 1012hr GMT, and ending in a long straight-in approach to Kinshasa on the southern side of the Congo river.

We refuelled as quickly as possible and were on our way again by 1225hr bound for Livingstone, Zambia, where we planned to stop for the night. This part of the journey took us over Angola. In the heat of the afternoon massive thunderstorms began to develop, and as dusk fell we were treated to a magnificent display of lightning, the boiling clouds seeming to be on fire with brilliant flashes deep inside them. Talking to Lusaka, the Zambian capital, on short-wave radio, we were informed that Livingstone would be closed for the night before our estimated time of arrival (ETA) and so a decision was made to divert to Lusaka, where we landed 40min after sunset to end a flight of just over five hours. The following day saw us dodging round Cbs — cumulonimbus clouds — on our way south over what was then still Southern Rhodesia, via Bulawayo to a landing at Jan Smuts Airport, Johannesburg. Total flight time from Douala was 11hr 50min.

After meeting up with the South African sales team, in between heavy thunderstorms we positioned the aircraft to the old Rand airport which was to be our main base of operations. At this point it was necessary to transfer the aircraft to the South African civil register, and in due course the registration ZS-IGI was painted on. That was the easy part. For some reason the fact that a British aircrew was planning to operate scheduled passenger flights for a variety of airlines in South African airspace presented something of a problem to the civil aviation authorities. We ran into a wall of red tape which, for a while, looked like jeopardising the whole carefully planned programme. To resolve the problem, we all had to trek off to the South African Civil Aviation Authority in Pretoria where, initially, the organisation insisted that we would have to sit an Air Law exam and RT test before it would allow us to continue.

After some discussion, it was decided that these requirements could be bypassed, provided that I was the only one to use the radio! We didn't stop to work out the logic of this; we beat a hasty retreat back to Rand and on December 11 departed in our newly repainted aircraft across the Kalahari Desert to Windhoek (Eros Airport) in South West Africa (now Namibia), on charter for *Suidwes Lugdiens* (South West Airways).

Good use is once again made of the 748's forward freight door during a stop at Ondangwa in South West Africa (Namibia), as the tour's chief pilot Harry Fisher looks on during the second half of the sales tour.

LEFT *Members of the 748 sales team at Pretoria during bureaucratic negotiations with the South African authorities, including pilot Harry Fisher (second from left) and Head of the Sales Department John Howarth (third from left).*

BELOW *A typical bird's-eye-view of the apron at Douala Airport, the French influence being much in evidence with the presence of a Nord Noratlas, Dassault Flamant and Max Holste Broussard, alongside a pair of Cameroonian Air Force Douglas DC-3s.*

ABOVE ***Wearing its South African registration, ZS-IGI, and with the legend "Hawker Siddeley 748" replacing its Air Afrique titles for the South African part of the sales tour, the 748 offloads its behatted passengers, and all the possessions they need for a year in the nearby copper and lead mines, at Ondangwa, South West Africa (Namibia).***

On December 12 we positioned to J.G. Strijdom Airport (now Hosea Kutako International Airport) near Windhoek, where we took on board a full load of young African men who were bound for a year's work in the diamond mines at the mouth of the Orange River. Two hours later we landed at Alexander Bay, offloaded the passengers and then flew across the river to Oranjemund (10min) to have a look at the airfield there. Then it was straight back to Alexander Bay to pick up another load of passengers who had completed their year in the mines and were on their way home.

Our next destination was Ondangwa, 3½hr to the north near the Angola border. The terrain was mountainous to the south but gradually became savannah woodland to the north of Windhoek. During the last part of the flight we flew across the Etosha National Park, a vast salt lake. The airfield was just a runway without airport buildings, laid out on the flat scrubland. Having offloaded our passengers, who wandered off into the bush carrying their few possessions, we positioned to Grootfontein, ready for a similar operation the following day.

The next morning at 0500hr we flew back to Windhoek (Strijdom), where we picked up more passengers. A South West Airways DC-3 set off ahead of us, the plan being to land at a remote airstrip at Rosh Pinah, 15min flying time from Alexander Bay, a strip occasionally used by the airline's Dakotas. We overtook the DC-3 en route and landed at the strip to watch it land and park alongside the 748. The airfield was surrounded by rugged hills, the whole area looking like a lunar landscape with no discernible sign of human habitation. Having demonstrated the 748's ability to cope with rough strips, we made the short flight to Alexander Bay, disembarked our passengers and then flew back to Jan Smuts.

TO MOZAMBIQUE, SOUTH AFRICA AND HOME

The following day we were off again, this time on a one-day charter for Air Rhodesia to Vilanculos, in southern Mozambique, where we enjoyed a brief dip in the Indian Ocean. This charter amused us no end, as the UK was imposing sanctions on Ian Smith's Southern Rhodesia at the time. After two days off, we made our final charter out of Johannesburg to Matsapa in Swaziland for Swazi Air, completing a local demonstration flight there before returning to Jan Smuts for our final night stop.

At 0915hr on December 18 we left Jan Smuts for the 3½hr flight southward to Malan Airport, Cape Town — a rough flight in turbulent conditions trying to avoid many thunderstorms. We then began a final series of flights for Cape Air, eastward along the coast to such places as Oudtshoorn, George and Plettenburg Bay, as far east as Port Elizabeth. These last two days of our tour, December 20–21, were the toughest of all, each consisting of eight sectors with an extra demonstration flight thrown in on the last day at Port Elizabeth in a 40kt wind. The longest sector was 1hr and the shortest 15min.

On December 22 we flew back to Rand Airport at Johannesburg, where I said goodbye to most of the crew, who were staying over Christmas. Later that day I flew back to England in style — First Class via Nairobi and Frankfurt in a BOAC Vickers Super VC10 — just in time for Christmas with the family and a good dose of Asian flu.

After Christmas it was back to the usual round of scheduled services and Ford charters until, during the autumn of 1970, we began to notice the first ominous signs that all was not well financially at Skyways. One obvious sign when away from base was the way the refuelling bowser would be parked directly in front of the nose of the aircraft and left there until the captain had paid cash for the fuel.

During 1967–70 the Transport Holding Company had advanced large loans to Skyways Coach-Air, but in November 1970, when Skyways requested a further advance to carry it through the winter period, the Department of the Environment stepped in to block any further loans. As a result, the company ceased operations on January 20, 1971. The four 748s and three Dakotas were grounded while attempts were made to rescue the airline.

Rescue eventually came in the form of a group of senior company employees who put in a successful bid for the airline, backed by Sterling Securities. The deal included the four 748s, with the three Dakotas being transferred to Air Freight, which subsequently moved its base to Lydd Airport. The new airline, now named Skyways International, resumed services on February 8, 1971, but by this time I had moved on to pastures new — Fordair. In my five years with the company I had flown more than 2,600 hours in the 748, gaining in the process a great deal of valuable operational experience.

Skyways International soon became Dan-Air Skyways and was eventually absorbed completely into Dan-Air Services. Thus, the last of the small independent airlines, operating out of its own small airfield away from the main airports and air routes, had succumbed to the new economic and political pressures which were to change the face of the British airline industry in the years ahead.

RIGHT ***Probably the most remote airstrip of the whole African tour was Rosh Pinah in South West Africa, an important settlement for the mining of zinc, lead, copper and diamonds.***

BELOW ***Southwest Airways DC-3 ZS-DJZ clatters overhead at the airstrip at Rosh Pinah before landing. The 748 took off from Windhoek before the Dakota, but overtook it en route and had landed, shut down its engines and disgorged its passengers by the time the DC-3 arrived.***

HEAVY DUTY

LEBANON'S DIY "HUEYBOMBERS"

In 2007 Lebanese armed forces were subjected to a series of attacks by a militant Sunni Islamist group occupying the fortified Nahr al-Bared refugee camp in northern Lebanon. **JOÃO PAULO MORALEZ & VATCHE MITILIAN** reveal how the Lebanese Air Force, then equipped only with helicopters, used old Hawker Hunter parts to solve a major operational problem

ALL PHOTOGRAPHS VIA AUTHORS

A pair of UH-1Hs at Kleyate Air Force Base north of Tripoli in northern Lebanon in 2007. The nearest has been converted into a "Hueybomber" with the help of parts taken from various other Lebanese Air Force aircraft, including its then-non-airworthy Hunter FGA.70s and its Aérospatiale Gazelle helicopters.

FROM THE HIGH ground about a mile from the sea, the water seems vivid gold and silver, glittering with the movement of the waves. This is where the Phoenicians set out to spread culture and open trade routes in the 1st Century BC. The scene is remarkable, like something from a classic Hollywood movie — or would be were it not for the rising mountains of sand, ash and debris where hundreds of mid-rise buildings used to stand. Hanging in the air, a tiny black point releases two small specks that start falling slowly, gaining speed as the seconds tick by. Ten, eleven, thirteen . . . boom! A black and orange plume reaches skywards moments later, accompanied by the sound of nearby celebrations. It is the conclusion of another bombing sortie by a Bell UH-1H Huey helicopter of *Al Quwwat Al Jawwiya Al Lubnaniya* (Lebanese Air Force — LAF) on the Nahr al-Bared refugee camp near Tripoli in northern Lebanon in 2007.

When faced with dire situations, actions and risks have to be taken that, under normal circumstances, would perhaps be deemed unthinkable, particularly if the situation involves fighting on home soil. It was precisely under such circumstances that Lebanon took the decision to convert part of its force of unarmed utility helicopters into bombers.

THE POLITICAL BACKDROP

In 1994, in the wake of the devastating 1975–90 Lebanese Civil War, the LAF withdrew its last Hawker Hunters from service, leaving the air arm with no fixed-wing combat aircraft. The following year Lebanon acquired 16 UH-1H Huey utility helicopters from the USA (further deliveries making a total of 24) for use in the transport, search-and-rescue, firefighting, troop transport and agricultural spraying roles.

The Hueys provided sufficient support during the period of relative peace up until July 2006, when Israel mounted attacks on Lebanese territory after the Shi'a Islamic militant group and political party Hezbollah, based in Lebanon, fired thousands of surface-to-surface rockets into Israeli territory. Fighting continued until August that year, despite Lebanon having little with which to oppose Israel's retaliation attacks. Unlike most of the world's air arms, the LAF is part of the bigger structure of the Lebanese Armed Forces and is therefore subordinate to it.

OPPOSITE PAGE ***By some margin the most used aircraft in the Lebanese Air Force, the Bell UH-1H has proved to be a versatile and enduring asset used in numerous roles — including that of bomber, as demonstrated in this photograph of a UH-1H carrying a full load of two 500lb bombs on pylons and one 400kg (880lb) bomb on its belly.***

ABOVE ***Huey serial L-1004 has its Lycoming T53 turboshaft engine run up in preparation for a bombing mission, armed with a single 400kg (880lb) general purpose (GP) bomb on its belly mounting. Owing to minimal ground clearance when carrying the bomb, and for easier fitting, the helicopter is positioned on a pair of steel supports.***

Following the intervention of the United Nations in August 2006 and the end of hostilities between Lebanon and Israel shortly afterwards, another period of relative calm ensued. However, a series of political problems within Lebanon the following year forced the nation to face its worst domestic conflict since the end of the civil war.

A NEW CONFLICT

In mid-May 2007 members of the radical Sunni Islamist militia *Fatah al-Islam*, a movement created in November 2006 with close links to Syria and ideological links with *al-Qaeda*, launched a wave of attacks against Lebanese Army post guards, killing 20 soldiers and leaving several others injured near the Palestinian refugee camp at Nahr al-Bared (Cold River), located 12½ miles (20km) north of Tripoli and 50 miles (80km) from the capital, Beirut.

Contrary to what was widely reported in the media, this was not a simple refugee camp. Its origins date back to 1949, when it was established by the League of Red Cross Societies to house Palestinians who lived in poor conditions and suffered from the intense winters in the Bekaa Valley and around Tripoli.

Over time the camp grew and, owing to its strategic position by the sea, drew the attention of the Lebanese authorities and the leader of the Palestine Liberation Organisation (PLO), Yasser Arafat, who used the area as a base and as a means of protection from his enemies, such as Israel. Gradually, Nahr al-Bared became an underground fortified-bunker complex, interconnected by a vast network of tunnels built by East German engineers in the early 1980s. This complex provided Arafat with areas for training and warehouses for food and ammunition. With the withdrawal of the PLO in the mid-2000s, the complex was gradually occupied by the militants of Fatah al-Islam.

As hostilities between the Lebanese Army and Fatah al-Islam intensified, diplomatic steps were taken in an attempt to avoid a further escalation of violence. The Army demanded that all militants responsible for attacks against Lebanese soldiers be handed over to the authorities. Unfortunately, such actions were unsuccessful and there was no agreement between the opposing sides.

Thus the conflict began in earnest, and in the early hours of June 1, 2007, the Lebanese Army surrounded the site with regular troops. Elite special forces squads also initiated operations against the guerrillas inside the camp to restore order in the region. At the time, some 40,000 people were living in Nahr al-Bared, a tiny area of less than a square mile (2·5km²), a mere 650ft (200m) wide and 650–820ft (200–250m) long.

Although better trained, better equipped and numerically superior, the Lebanese Army was

ABOVE ***The "DIY" bomb-rack fitted to the LAF Hueys incorporated a weapons pylon from a Hunter (the harness marked with a warning triangle) attached by means of a missile attachment arm from a Gazelle, which in turn was connected to a propshaft (taken from a Navy vessel), which was attached to an armoured plate on the cabin floor.***

confronted with an environment similar to the favelas of Rio de Janeiro in Brazil or Cité Soleil in Haiti: hundreds of streets and narrow alleys forming an immense labyrinth which impeded the advance of troops, even with the support of artillery and armoured vehicles. Soldiers could be ambushed at any moment and lacked experience in this type of warfare. To make matters worse, there were no maps of the area, no photographs and no consistent intelligence on the complex. The result was that within days the Lebanese Army had begun to suffer heavy casualties among its highly specialised troops.

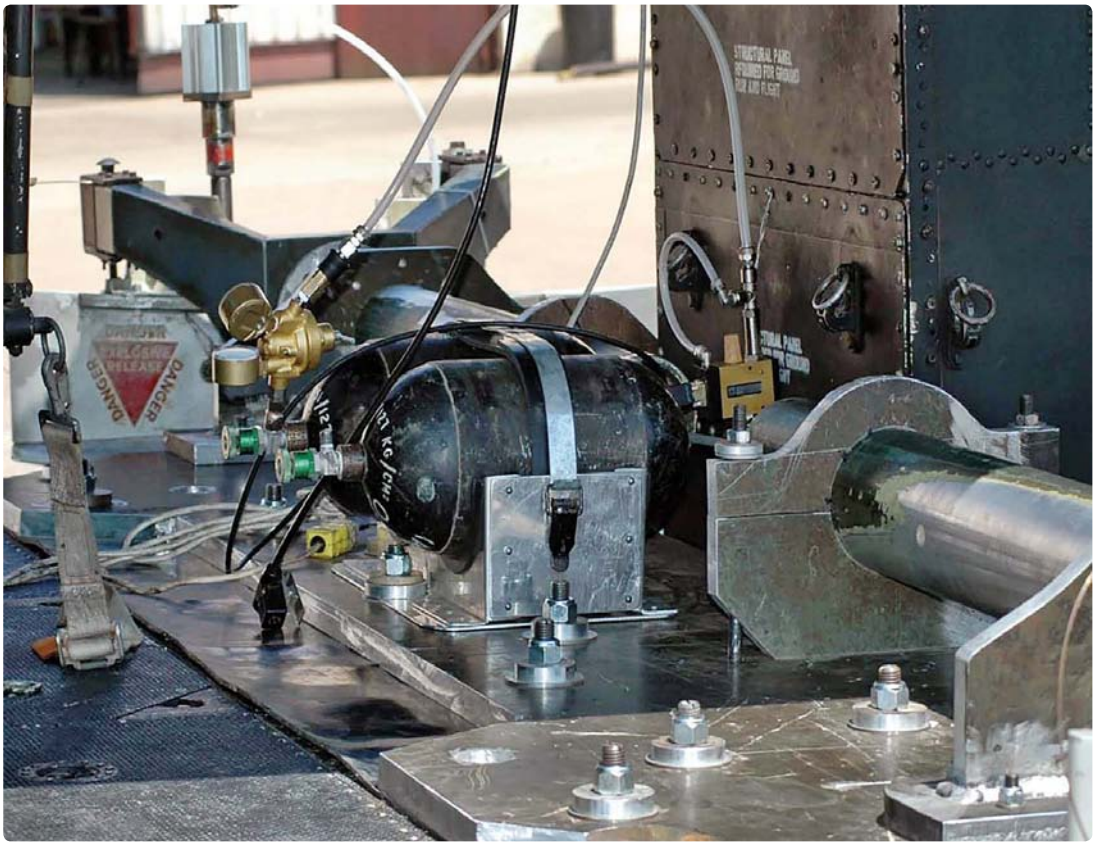
While the Lebanese Army faced challenging conditions on the ground, the LAF was fulfilling its designated roles of armed reconnaissance, escort and medevac (evacuation of wounded soldiers in the field), the latter being an important morale-booster for the Army troops. More than 130 such medevac missions were undertaken during the conflict.

LIMITED RESOURCES

The LAF had little more to offer. The civil war had reduced much of the country's infrastructure to rubble, which led to a reallocation of resources away from the military and ultimately, a severe reduction of spending on the nation's armed forces. By the time the fighting in Nahr al-Bared had broken out, the LAF's inventory comprised 23 UH-1Hs (at least half of which were unserviceable), four Robinson R44 four-seat light helicopters for basic training and nine Aérospatiale SA.342L Gazelle light transport/ground-attack helicopters donated by the United Arab Emirates Air Force. The Gazelles arrived a month before the start of the conflict, by which time only three were airworthy. Two could be armed with 0·50in machine-guns and unguided 70mm rockets and the third could be fitted with HOT wire-guided anti-tank missiles.

On July 1 the Gazelles entered operational service and, for the first time, performed a series of attacks against the Fatah al-Islam fighters and their infrastructure. All flight operations were concentrated at Kleyate Air Base (aka Rene Mouawad Air Base), previously home to the LAF's Dassault Mirage IIIB/Es, only 7½ miles (12km) from the camp. The Gazelles managed to destroy some vehicles and small buildings, but lacked the firepower to penetrate the militia's underground shelters. As a result, the Lebanese Army continued to suffer casualties without winning major advances in the field.

Clearly, the solution was to devise a method of undertaking air attacks with bombs, despite there being no apparent means to do so. However, there began to emerge within the LAF a movement to find such a solution that, it was hoped, would bring a swift end to the conflict. The first step was to reactivate four of the eight Hunters still stored in hangars at Rayak Air Base



ABOVE ***The ingenious arrangement within the cabin comprised a pair of oxygen bottles also taken from the Hunters, attached to an armoured plate (from an M113 armoured personnel carrier) which was bolted to the floor. The bottles fed compressed air to the release piston, the silver starboard example of which is seen here top left.***

ABOVE ***Of more slender form than its larger 400kg counterpart, the Mk 82 unguided low-drag GP "dumb bomb" is one of the most widely-used in the world and was dropped in huge numbers during the Gulf War of 1991. The Mk 82s used during the siege of Nahr al-Bared were modified by LAF armourers, and a number were produced locally.***

One of the Hueybombers sits on a makeshift concrete platform at Kleyate while being prepared for its next bombing mission, this time carrying a single 400kg belly-mounted bomb. The bombing missions were mostly made during the day, but more than 4½hr of combat mission flight time was accrued at night during the 2007 conflict.

in the Bekaa Valley, and return them to operational status in order to perform ground-attack missions on Nahr al-Bared. Accordingly, Hunter L-284 undertook taxying tests in August 2007, but lacked important items needed to make it fully operational again, including explosive cartridges for the ejection-seat. To circumnavigate these difficulties, another far more ingenious solution began to take shape; it was an unusual idea, but one which — if executed correctly — could prove highly effective.

THE MOTHER OF INVENTION

The LAF's armourers, technicians and engineers set about surveying what was available at various air bases, carefully auditing everything that had been stored since the end of the civil war. Despite the LAF having sold its Mirage IIIs to Pakistan in 2000, its French SAMP T200 400kg (880lb) general-purpose (GP) bombs had been properly preserved and stored, as had its USA-built 500lb (250kg) Mk 82 GP bombs. The next step was to work out how these bombs could be carried, there being no fixed-wing aircraft capable of doing so. The solution was the ubiquitous workhorse that until that point had been conducting only utility transport missions — the UH-1H Huey.

After some swift feasibility studies, LAF technicians developed a system to launch bombs from a Huey unlike any conventional method ever seen before. The installation was ingenious: an aluminium plate from an M113 armoured personnel carrier (APC) was installed on the floor of the helicopter's main cabin, bolted to which was a propshaft taken from a Navy ship. The propshaft extended out through the Huey's main cabin doors on both sides, at which point pylon housings from a Gazelle were attached to the shaft. On to this housing was fixed a weapons pylon from a Hunter, on which the bombs were carried. When fitted to a Hunter, the bombs were released using a hydraulic system, which the Huey did not have, so two Hunter oxygen bottles were connected to the pylon by a tube system, so that compressed air could be used to launch the bombs from the pylon.

This novel system could carry two Mk 82 GP bombs — one on each side. Furthermore, the under-fuselage hook of the Huey could carry a single bomb of up to 400kg (880lb). To increase the bombs' potency, the LAF replaced their standard explosive charges with a material similar to the plastic explosive C4. As bomb stocks were low, local production and modification was initiated to ensure a regular supply and continuity of the campaign against the guerrillas. The bombs' fuzes were improved by technicians, and the amount of explosive charge increased from 196lb (89kg) to 225lb (102kg),

LEFT ***Lebanese Air Force armourers worked hard to produce stocks of bombs for the Hueybomber missions to Nahr al-Bared. Here a pair of technicians work on the business end of a 400kg bomb based on the French SAMP T200.***

BELOW LEFT ***Working in collaboration with the Lebanese Armed Forces Engineering Division, the LAF armourers modified and developed LAF bomb stocks. Improved 400kg T200 bombs were thus redesignated as LAF-GS-ER-03s, as seen here.***

BELOW RIGHT ***A 400kg bomb is wheeled out using an improvised trolley with homemade wooden cradle, from which it will be hoisted into the belly mounting of a Hueybomber and flown the 7½ miles to its target.***

Pallets of 400kg GP bombs in the hangar at Kleyate in 2007. On August 24, 2007, a ceasefire was declared to allow more than 60 women and children to leave the camp, with bombing missions resuming the following morning. Within ten days the remaining militants had surrendered and the conflict was over.

ABOVE ***In early August 2007, UH-1H serial L-1005 was fitted with the cabin bomb-mounting apparatus and tested with various arrangments of ballast to investigate the system's viability. It is seen here with a ballast cradle on its starboard mounting. On August 9, this aircraft completed the first operational Hueybomber mission of the conflict.***

and in some cases to 258lb (117kg), in the Mk 82. The Mk 82 bombs were thus redesignated as LAF-GS-ER-02s. A Lebanese-manufactured 400kg bomb, similar to the French T200, was designated LAF-GS-ER-03.

All tests of the new system were completed at Rayak, an exclusively military airfield and one of the LAF's best-equipped air bases. For the trials the military used a ballast of 250kg (500lb) to simulate the aerodynamic effects of the bomb. By August 7, Huey serial L-1005 of the Beirut-based 10th Sqn had been fitted with the complete launch system, and on that day the LAF conducted the first test in a field near Rayak.

The two days of trials were successful, and on August 9 a bomb-laden Huey took off from Kleyate AFB to conduct the first mission over Nahr al-Bared. The results were good, the efficacy of the "Hueybomber" coming as a big surprise to the enemy. With the concept proven, a stream of Hueys with a Mk 82 on each side or a 400kg bomb under the belly (and sometimes all three) began launching.

THE MISSIONS

A Hueybomber crew consisted of two pilots and a mechanic. The helicopter launched with sufficient fuel in the tanks to take off, fly the 7½ miles (12km) to Nahr al-Bared, drop the bombs and return. The cabin door was removed in order to minimise the weight of the helicopter. These missions were possible for the single-engined UH-1Hs only because the camp was so closely situated.

Satellite co-ordinates for the Hueys' targets were passed to the pilots either by ground forces or intelligence sources. Using two onboard GPS devices, the attacks were made at an altitude of 3,000ft (900m) or 1,500ft (450m), usually at a speed of about 110 m.p.h. (180km/h); the free-fall time of the bombs was 13·6sec from 3,000ft and 9·6sec from 1,500ft. The LAF dropped 93 bombs during 98 bomber missions over 26 days of operations. The Hueybombers accrued a total flight time of 46hr 30min, some 4hr 35min of which was flown at night. The operations revealed that the 400kg T200 was ineffective because of its low penetrating power and its use was therefore very limited during the campaign.

One Lebanese Army General, who declined to be identified, relates:

"I participated in 45 days of operations at Nahr al-Bared. The morale of our soldiers rose when they saw the helicopters approaching and dropping bombs. They knew this would hurry the end of the fighting. Regarding losses, we did not suffer any incidents during these operations, despite more than ten helicopters operating out of Kleyate throughout August. We found out later that the bombs had caused a great impact on the guerrillas who, locked inside their shelters, could only await the next round of bombs. We did everything systematically and, for them, it was interminable."

Largely as a direct result of these attacks, the Fatah al-Islam fighters surrendered to the Lebanese Army on September 3, 2007. More than 180 Lebanese Armed Forces soldiers lost their

ABOVE ***A Hueybomber heads off on another mission with a pair of 500lb Mk 82 GP bombs attached to its home-made pylons. The LAF continues to operate the UH-1H, although its acquisition of six Embraer EMB-314 Super Tucano turboprop ground-attack aircraft means it is unlikely that the Hueybombers will be called into action again.***

lives and another 400 were wounded. More than 225 Fatah al-Islam fighters were killed and 220 were captured. "If not for the helicopters, we might have lost more lives and taken twice as long to win this battle", said the General.

During the Nahr al-Bared conflict the Hueys also completed 76 observation, armed reconnaissance and photography missions, as well as 13 escort missions armed with 7·62mm coaxial machine-guns. The Robinson R44s also underook transport and radio-relay missions. The Hunters did not participate in the fighting at Nahr al-Bared, but were put back into service on October 12, 2008.

The LAF Hueys were also fitted with Matra Type 155 pods for 68mm SNEB rocket projectiles taken from the Hunter, a capability extended to the LAF's twin-engined Aérospatiale Puma helicopters, which can be fitted with two Aden 30mm cannon and a Matra Type 155 rocket pod plus up to four Mk 82 bombs. At least four Pumas were thus locally modified.

THE SITUATION TODAY

Lebanon is currently in the process of modernising its armed forces and has three single-seat Hunter FGA.70s and one T.7 two-seater in "active storage", although these have not flown since 2014. The air arm operates three Cessna 208B Caravans on reconnaissance and ground-attack duties, the latter with Hellfire missiles, as well as four R44s and three Scottish Aviation Bulldogs for training purposes, plus 23 UH-1Hs for general purpose and bomber duties. Also on strength are seven SA-330/IAR-330 Pumas; six upgraded UH-1 Huey IIs; eight Gazelles; one Agusta-Westland AW139 presidential transport helicopter; six Embraer EMB-314 Super Tucano fixed-wing aircraft and three Sikorsky S-61N helicopters.

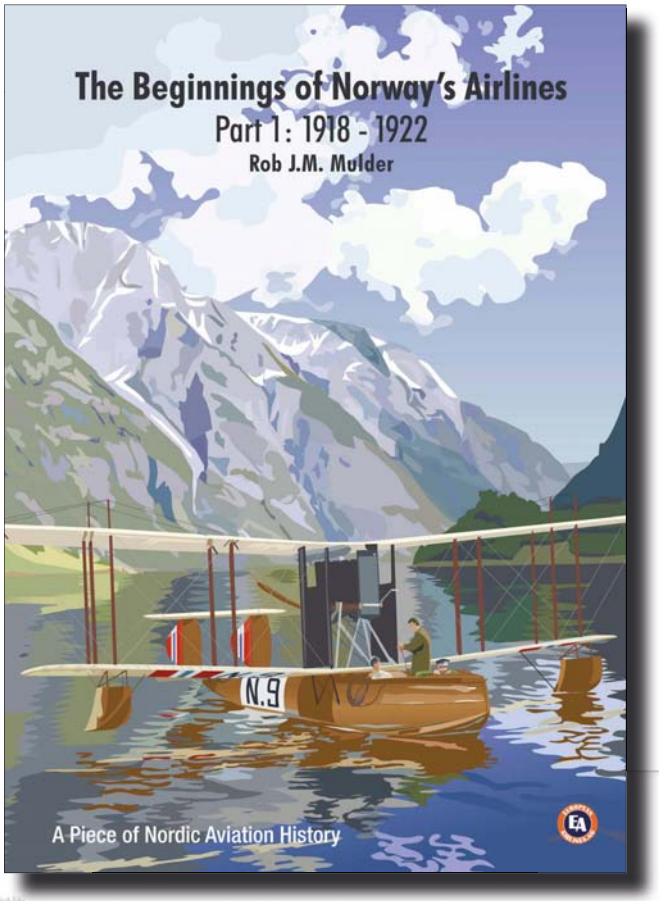
During the Battle of Nahr al-Bared, the LAF demonstrated its ability to find a practical solution to a major operational problem by combining the equipment at its disposal with the ingenuity of its technicians, leading to the birth of Lebanon's DIY Hueybomber force.

■ This revised and updated article was published in its original form in Vol 36 No 4 (No 144) of *The Small Air Forces Observer* (**www.safch.org**) in April 2013

1918–2018: 100 YEARS OF NORWEGIAN COMMERCIAL AVIATION
THE BEGINNINGS OF NORWAY'S AIRLINES

July 10, 1918, marks the centenary of the establishment of Norway's first airline, Det Norske Luftfartrederi (DNL). Operations did not start until 1920, however, when the new company won a bid to operate a service from Stavanger to Bergen via Haugesund. Other companies were not far behind, no fewer than six airlines inaugurating services in Norway between 1918 and 1922.

This first volume in European Airlines' new series on Norway's airlines takes an in-depth look at the companies formed during 1918–22, including the aircraft imported and the people involved, using numerous photographs, many of which are published here for the first time. The second part, available soon, covers 1923–34.



Author: Rob J.M. Mulder
Format: 215x302mm, hardback, ca. 192 pages, ca. 200 photographs, many colour profiles, English text only
ISBN: 978-82-93450-04-7
Price: £ 34,95 + postage

Visit our webshop to take a look at a great selection of aviation books, including those of other specialist publishing companies.

Orders at:
WWW.EUROPEANAIRLINES.NO

TRIMOTORS over the CHANNEL

Situated off France's Normandy coast, some 100 miles south of the British mainland, the Channel Islands presented a highly attractive proposition for Britain's inter-war airline pioneers, who took advantage of the safety and economical benefits of three-engined aircraft to establish services across the English Channel, as **MATTHEW WILLIS** relates

RIGHT ***A splendid contemporary advertisement poster for Portsmouth, Southsea & Isle of Wight Aviation Ltd's air ferry service between Portsmouth on the mainland and Shanklin and Ryde on the Isle of Wight, featuring the company's specially modified Westland Wessex trimotor, G-ABVB.***
TAH ARCHIVE

BELOW ***Only two Saro Windhovers were built, Jersey Airways acquiring the second, G-ABJP (c/n A.21/2) in May 1935 from the Hon Mrs Victor Bruce, who is seen here in the aircraft preparing for one of her several attempts on the world flight-refuelling endurance record in 1932.***
VIA AUTHOR

ON MAY 31, 2017, the last few passengers stepped out of a small 18-seat airliner at Guernsey Airport and brought to an end one period of history that had lasted since 1971, and another that went back to the mid-1930s. As Aurigny Air Services' Britten-Norman BN.2A Mk III Trislander G-BEVT discharged its passengers and freight, it represented what was in all probability the last piston-engined trimotor to serve the Channel Islands.

The distinctive sight and sound of the Trislander and its three Lycoming O-540 flat-four engines had been an intrinsic part of the Channel Islands landscape since the first of the type in service flew its first scheduled trip until it was finally — after many attempts — replaced with turboprop-powered aircraft from 2014. The link between piston-engined trimotors and the Channel Islands, however, dates back to a time long before Aurigny, the States-owned airline for the Channel Islands, recognised the value of the Trislander in the early 1970s. The relationship goes back to the early days of the air link between mainland England and the first permanent aerodromes on the islands.

The first scheduled air service to the Channel Islands began in 1923. There were no suitable airfields on the islands at the time,

TAH ARCHIVE

ABOVE ***Originally built with Cirrus-Hermes engines as the second Westland IV, G-AAGW was modified to Wessex standard with the incorporation of Genet Majors. While operating with Imperial Airways, 'AGW was chartered by the Great Western Railway for a pioneer service between Cardiff and Plymouth, where it is seen here, in April 1933.***

so the service, operated by British Air Marine Navigation Ltd, a subsidiary of Supermarine, was established with flying-boats. Initially three Supermarine Sea Eagles used Jersey and Guernsey's harbours to transport passengers between the islands and Southampton on the mainland. The flying-boat service was less than ideal, however, as the loss of one of the Sea Eagles, rammed by a ship in Guernsey's St Peter Port, attested. The service was taken over by Imperial Airways but ceased altogether in 1929. An attempt by a small operator to use a Saunders-Roe Cutty Sark twin-engined flying-boat failed after less than a year, in 1930.

The islands' residents desperately wanted a service that could properly link them to mainland England, and not just the coast. It proved possible to fly landplanes from the beach at West Park, near St Helier on Jersey, although this was still highly dependent on the tides. Moreover, a transfer to the other islands still had to be arranged. Moves were made to build proper airports on the main islands, but these would take years to complete.

Probably the islands' first acquaintance with a trimotor was the British Air Navigation Company's Ford 4-AT-E G-ABHO *Voyager*, which was loaned to Portsmouth, Southsea & Isle of Wight Aviation Ltd (PS&IoWA) when more passengers (nine) wanted to travel than the airline's de Havilland D.H.84 Dragons could carry. *Voyager* made a successful landing and take-off from West Park's beach, but it was a one-off and not repeated.

In 1935 Alan Cobham, the famous barnstormer, record-setting pilot and flight refuelling pioneer, saw an opportunity. He wished to create an air route connecting London with the Isle of Wight and the Channel Islands. By this time Guernsey had a small airstrip at L'Erée which hosted the Guernsey Aero Club, of which Cobham was a member. It was adequate for light aircraft, but nobody had previously thought of operating airliners from it. Cobham thought it might be possible and sought a small airliner capable of carrying a reasonable load from the very short 450ft (140m) airstrip, use of which was also complicated by houses and overhead cables at one end of the runway. It seemed that a trimotor might provide the solution. In fact the layout was to prove uniquely suitable for serving the islands in the 1930s, as it would more than four decades later. Cobham identified his ideal aircraft as the Westland Wessex, a three-engined six-seater developed during 1929–30.

THE MAGIC NUMBER

The fashion for aircraft powered by three piston engines was kickstarted to a large degree with the conversion of a Fokker F.VIIa for the 1925 Ford National Reliability Tour in the USA. In the interests of reliability and serviceability, the single powerful liquid-cooled engine was replaced by three simpler and lighter air-cooled engines. The resulting F.VIIa/3m was the catalyst for Fokker's total dominance of the regional airliner market in the late 1920s. A profusion of aircraft followed the pattern of the Fokker trimotor, in the shape of designs both created with three engines and modified single- or twin-engined types.

The advantages of three engines over one were significant; the failure of any one engine would leave the aircraft with two-thirds of its power still available, while the asymmetric thrust following a failure was mitigated far better than on a twin-engined design. The trimotor configuration also put fewer demands on the airframe's structure than that of a twin of equal power or a four-engined aircraft.

VIA AUTHOR

ABOVE ***Belgian national airline Sabena acquired four Wessexes — OO-AGC, 'AGD, 'AGE and 'AGF — during the summer of 1930; OO-AGD was destroyed in a hangar accident at Evère in December 1934, but the three remaining examples were purchased by Alan Cobham in March 1935 and put to work on his Bournemouth—Guernsey route.***

Various arrangements of the three-engine layout were tried, but on landplanes the most popular by far was that of the Fokker, with a single engine in the nose and the other two mounted beneath the wings. The best known and most numerous were those built by Fokker and Ford in the USA, but many others were built in small numbers by British manufacturers, including Short Bros, Avro, Armstrong Whitworth and Handley Page.

The Westland Aircraft Works was well occupied in the late 1920s with building aircraft for the RAF, chiefly the Wapiti and Wallace general purpose biplanes, but the company also harboured ambitions in the booming civil market. In 1928 the company began work on the Westland IV "feederliner", which had developed into the definitive Wessex trimotor by 1930, using some Wapiti components (most notably the rudder) in its mixed wood-and-metal construction. Westland followed the proven layout of the Fokker, on a slightly smaller scale, to provide an aircraft capable of carrying six passengers, powered by three Armstrong Siddeley Genet Major IA air-cooled radial engines (the same engine chosen to power Avro's 619 "Five" aircraft, a scaled-down F.VII/3m similar in many respects to the Wessex).

THE AERIAL BUS

Ten Wessex aircraft were built, including the two Westland IV prototypes updated to production standard. Four were operated by Belgian national airline Sabena (which at the time was equipped almost entirely with trimotors of various types including Fokker, Savoia-Marchetti and Junkers) and three by Imperial Airways. Cobham purchased three of Sabena's aircraft — OO-AGC (re-registered G-ABAJ), OO-AGE (G-ADEW) and OO-AGF (G-ADFZ) — and the upgraded first prototype, G-EBXK. A Wessex extensively modified specifically for the company, G-ABVB, was used by PS&IoWA from June 1932 and on its inaugural ferry service from Heston, near London, to Ryde on the Isle of Wight, which had a runway of only 670yd, in early May 1934.

Cobham created something akin to an aerial bus service from Croydon to Guernsey, with stops at

Wessex G-ABVB was built specially for PS&IoWA and incorporated a number of modifications, including a strengthened undercarriage, increased rudder area and a reduction in baggage area in order to accommodate eight passengers instead of the standard six.

PHILIP JARRETT COLLECTION

TAH ARCHIVE

ABOVE ***Showing the raised cockpit fitted to PS&IoWA's Wessex to good effect, G-ABVB passes Spithead while plying its trade between Portsmouth and the Isle of Wight. The company inaugurated its Wessex service in June 1932 with four daily Portsmouth—Ryde flights, the aircraft opening a London (Heston)—Ryde service in May 1934.***

Portsmouth (which connected with PS&IoWA's service to Ryde with G-ABVB), Southampton and Bournemouth. *Flight* welcomed the development, stating that the "complicated land and water journey will be simplified when Cobham Air Routes Ltd open, next Monday [May 6, 1935], a twice-daily service", adding that "the whole journey will be made in 2hr, including stops".

The Wessexes were used purely for the overwater part of the service, with Airspeed Envoy G-ADBA or Courier G-ABXN operating the sector between Croydon and Bournemouth. This was partly the reason for the short duration of the total flying time, as the Envoy and Courier were rather faster than the Wessex (the Croydon—Bournemouth run typically taking 30min and sometimes as little as 20min). The speed at which the operation was set up is made clear by the fact that Cobham Air Routes was only registered as a company on May 3, 1935, three days before the first service!

The overwhelming advantage of the Wessex for the Guernsey run was its short take-off and landing runs, while still being able to carry a useful payload. *Flight* noted that "the wing-loading has been kept down to 11·7lb/ft², a figure which, especially for a monoplane, gives not only a reasonably low landing speed, but also, in conjunction with fairly low span-loading, a fairly small value of induced drag and consequent good take-off and climb".

The Wessexes were initially based at Portsmouth, but transferred to Bournemouth each day for the Channel flight while a hangar was constructed at the latter for their use. It was further reported that L'Erée was having its runway extended and facilities improved, pre-empting the Island States' ongoing assessment of the best site for Guernsey's airport. The sites under consideration included L'Ancresse and La Villiaze as well as L'Erée.

At the end of Cobham's first month of Channel operations, the May 30, 1935, issue of *Flight* reported that the Guernsey service was "carrying fair loads, and there is no reason to suppose that this service will not be as much of a success as that to Jersey". The service was evidently popular, and *Flight's* commercial aviation commentator, "A. Viator", remarked on June 27, 1935, that Cobham Air Routes had "bookings for months ahead" on the Guernsey route. One of the more unusual of these was the entire Dagenham Girl Pipers group, 17 members in all, plus their "pipes, claymores, drums and all the usual accessories of a border raid", who were flown from Croydon to an engagement on Guernsey on Friday, June 14. Two Wessexes were used instead of the usual single machine, but it is still unclear how the pair of six-seaters managed to transfer all 17 pipers with their instruments and other equipment. As a herald of how successful the later air ambulance operations by Aurigny Trislanders would be, a "celebrated surgeon" flew by Wessex to Guernsey in the first couple of weeks of the service opening, following an urgent call to perform an operation on the Bailiff of the island.

BY LAND AND SEA

A month after the Guernsey service began, another trimotor of a very different type began an association with the Channel Islands. Jersey

PHILIP JARRETT COLLECTION

ABOVE ***The second Saro Windhover, G-ABJP, in the company's East Cowes hangar in the early summer of 1931. Before being acquired by The Hon Mrs Victor Bruce, it was owned by millionaire Francis Francis (see*** **The Blue Falcon** ***in*** **TAH20***), who sold it in September 1931 to Gibraltar Airways for use on its Gibraltar—Tangier service.***

Airways, a subsidiary of Channel Islands Airways, ran a regular, if highly tide-dependent, service to the beach at West Park on Jersey. At the beginning of June 1935 the company began flights in a three-engined flying-boat, Saunders-Roe (Saro) A.21 Windhover G-ABJP *City of Portsmouth*, between St Peter Port on Guernsey and Jersey and, later, Alderney. The Windhover was an amphibian with a retractable undercarriage, so was a particularly useful aircraft to operate during a phase when some destinations had functioning airfields and others still relied on the sea ports.

The Windhover was the second of two built, and was originally used in Gibraltar before being modified for an attempted long-distance flight by The Hon Mrs Victor Bruce. The six-passenger Windhover was part of Saro's family of flying-boats, which included the small A.17 four-passenger Cutty Sark and the larger eight-passenger A.19 Cloud. Each type was extremely similar, differing mainly in size and engine fit. The fuselage was of light metal construction and the wing was a cantilever plywood structure.

Saro had designed the type to be extremely flexible; thus, not only could the design be scaled up and down but each aircraft could be fitted with a range of different engines in various configurations. This led to a somewhat idiosyncratic situation in which the smaller and larger aircraft were both twin-engined, while the mid-sized Windhover had three engines, in the case of G-ABJP 120 h.p. de Havilland Gipsy IIs. In the 1920s the trimotor configuration was almost as prevalent on flying-boats as it was on landplanes. Given the need to place the engines and propellers well above the water to avoid water ingestion and spray damage, it made sense when arranging engines above the fuselage to place one on the centreline, giving most of the same advantages as a nose-mounted engine on a trimotor landplane. Unlike its twin-engined stablemates, Saro advertised that the Windhover was able to fly with any one of its engines out.

As Channel Islands Airways could not operate from L'Erée, a flying-boat was the only option, and the Windhover was the ideal size, being of the same capacity as the Wessex. Flights began in the first week of June 1935. Charles Eckersley-Maslin (formerly the RAF's test pilot at Karachi for all newly arrived aircraft, later a Squadron Leader RAF and Commander RN) was the chief pilot of Jersey Airways and test-flew the Windhover extensively around the Channel Islands before it went into service.

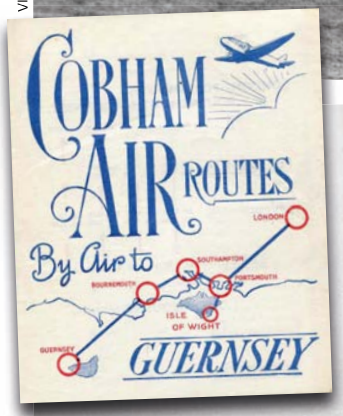
LOSS OF A WESSEX

Meanwhile, the Cobham Air Routes Croydon—Guernsey service quickly showed every sign of being a great success, despite the considerable limitations posed by L'Erée. Tragically, it would come to an abrupt end after just two months of operation in the summer of 1935.

During a flight from Guernsey to Bournemouth on July 3, the starboard engine failed on Wessex G-ADEW about 30min into the flight. Rather than turn downwind for the French coast, the pilot, W.H. Ogden, continued for Bournemouth. Initially all was well and the Wessex continued on two engines. However, at the increased power required of them, one or even both of the two

RICHARD T. RIDING COLLECTION

VIA AUTHOR



ABOVE ***Originally OO-AGF in Sabena service, G-ADFZ was acquired by Cobham Air Routes in March 1935 and used extensively on the company's short-lived Croydon—Guernsey service. In September that year it was involved in a mid-air collision with an Avro 504 at Blackpool, but was repaired and sold to the Trafalgar Advertising Co Ltd in early 1937.***

LEFT ***Passengers prepare to board PS&IoWA's G-ABVB. With the suspension of the Cobham Channel Islands service, Wessex G-ABAJ was leased from Cobham to PS&IoWA during a fleet expansion in the second half of 1935, and, like 'DFZ, also went to Trafalgar to be fitted with battery-powered neon lighting equipment.***

INSET BELOW LEFT ***A contemporary timetable booklet for Cobham Air Routes showing the intermediate stops on the London—Guernsey service, including the connection point with PS&IoWA at Portsmouth. From there, Wessexes G-ABVB and G-ABAJ would provide the onward service.*** DACRE WATSON COLLECTION

Following its brief time with Cobham Air Routes on the Channel Islands service, the original Westland IV prototype, G-EBXK, upgraded to Wessex standard, joined Alan Cobham's National Aviation Day Displays Ltd, with which it is seen here, probably at Ford. It was withdrawn from use in May 1936.

RICHARD T. RIDING COLLECTION

remaining Genet Majors failed when the aircraft was just short of the Isle of Wight. Ogden ditched three miles from the Needles, after having told the only passenger on the flight, Mr C.F.H. Grainger, to put on a lifebelt. The Wessex seems to have hit the water hard on ditching, probably owing to Grainger moving aft just before touchdown and upsetting the aircraft's longitudinal balance. Ogden was killed and the wrecked Wessex sank, but Grainger was able to escape and was picked up by the steamer *SS Stanmore*.

The Inspector of Accidents concluded that Ogden had taken an "unnecessary but not wholly unjustified risk" in continuing with the flight. It may be that he was lulled into a false sense of security by the trimotor's much-praised dependability, especially as the aircraft was particularly lightly loaded on this occasion. On the other hand, the decision to turn downwind can only be made once, and *Flight's* commercial aviation correspondent pointed out that even if the pilot does so and reaches the coast, it may not be possible to turn upwind again to land.

The Guernsey service was suspended with immediate effect. For the next few weeks, rumours abounded that it was to wind up altogether, but Cobham denied these, insisting that the delay was simply the result of work to extend and improve L'Erée. As it turned out, the Croydon—Guernsey service was at an end. Cobham Air Routes was experiencing cash-flow problems and Cobham sold the operation to Olley Air Services, which was then expanding its operations on the South Coast. Olley fully intended to begin the Guernsey service once again, and entered into a partnership with the island's Aero Club to complete the improvements to L'Erée and continue the popular run. However, despite objections from the club, the States voted to site the new airport at La Villiaze, further south and inland, instead of L'Erée, with the States' own airline, Channel Islands Airways, securing preferential status by paying for the construction of the airfield and a fee for a monopoly on commercial rights for five years. In the event, the airport at La Villiaze did not open until May 1939, and the first of the three biggest islands to gain a permanent airport was Alderney, which opened in 1936.

THE WINDHOVER PRESSES ON

No more Wessexes therefore made the flight across the Channel, although PS&IoWA's examples continued their flights across the Solent until June 1936, when G-ABVB crashed at Ryde. With the loss of the Croydon—Guernsey route, the latter island would be even more reliant on the Channel Islands Airways Windhover, which was now its chief means of linking by air to the other islands, and consequently to the mainland.

On April 6, 1936, the daily service between

Originally built as a pure seaplane, the first Windhover undergoes inspection at Saro's Solent Works (West Cowes) in 1930. Originally given the New Zealand registration ZK-ABW, the aircraft went to Australia instead, where it served Matthews Aviation as VH-UPB. Seen here without the auxiliary winglet above the engines later added to both Windhovers, ZK-ABW made its first flight on October 16, 1930. TAH ARCHIVE

TAH ARCHIVE

ABOVE ***With square Dural tubes replacing the wooden wing construction of the standard Wessex, and a complete metal fuselage, G-ABVB was designed specifically for PS&IoWA's high-density services, which called for a beefier structure to give it the ruggedness required for the more frequent take-off and landing cycles of short-haul routes.***

Southampton, Alderney and Guernsey was finally launched, having been expected to open late the previous year. Passengers were flown to La Grand Blaye on Alderney in de Havilland D.H.89 Dragon Rapides, and transfers to Guernsey were made via Windhover. According to Edward Pinnegar's *A History of Aviation in Alderney* (Amberley, 2015), the first flight from Guernsey to Alderney was performed in the teeth of a 40 m.p.h. (64km/h) headwind and took 33min. The pilot was William Halmshaw, like Eckersley-Maslin a former RAF pilot.

The Windhover was useful but unpopular. Its layout made it cramped and awkward within, as the wing spars cut across the fuselage, creating a forward cabin with four seats and an aft cabin with two, with the spars in between. Moving around in flight was impossible, and Pinnegar quotes a journalist covering the first flight who noted that "you spend most of your time ineffectually trying to keep dry" when taking off from the sea, so leaky were the cabin windows. The Windhover was also somewhat unreliable and often out of service, although the fact that it was the only aircraft of its type on the service meant that there was no possible replacement and its absences were therefore all the more obvious. The Windhover continued to operate into 1939, but with the imminent opening of La Villiaze and the increasing difficulty of keeping it airworthy, the trimotor flying-boat was withdrawn from use on March 10 that year.

That might have been the end of the trimotor's association with the Channel Islands. The improving reliability and increasing power of aero-engines, combined with the improved ability of aircraft to fly with asymmetric power, largely rendered the layout redundant. While numerous airliners employed the trimotor configuration in the 1920s, by the end of the 1930s only a few manufacturers clung to it. However, the trimotor was to return to the Channel Islands in the 1970s, proving again the practicality of a regional airliner powered by three piston engines.

BELOW ***Windhover G-ABJP while in service with Channel Islands Airways, the holding company for Jersey and Guernsey Airways. The aircraft inaugurated services between Guernsey's St Peter Port and St Brelade's Bay in Jersey in June 1935 (and to Alderney from August), the fare being set at 12s for a single journey and 18s return.***

VIA AUTHOR

ARMCHAIR AVIATION

We take a look at what's available for the aviation history enthusiast in the world of books and other literature, from hot-off-the-press publications to reissued classics

Under Their Own Flag: A History of 47 Squadron 1916–1946

By Owen Clark; Fighting High Publishing, 23 Hitchin Road, Stotfold, Hitchin, Herts SG5 4HP (www.fightinghigh.com); 11in x 8½in (282mm x 217mm); hardback; 160 pages; illustrated; £29.95. ISBN 978-0-993212-99-4

PUBLISHED TO MARK the squadron's centenary in 2016, this book tells the story of the unit's momentous first three decades and aims to place that story in a wider context. Formed at Beverley in East Yorkshire in March 1916, No 47 Sqn departed for Salonika in September the same year; it did not return to the UK until September 1946, so this volume neatly encapsulates the globetrotting phase of its existence so far.

Operations in far-flung parts of the world are reflected in the squadron's Latin motto, *Nili nomen roboris omen* (The name of the Nile is an omen of our strength), and the various locations provide the framework for the book's 11 chapters — as well as reading like a list of many of the RAF's battle or theatre honours. They cover UK 1916; Salonika 1916–19; Russia 1919; Russia 1919–20 (after disbandment and re-formation); Egypt and Sudan 1920–39; East Africa 1940–41; North Africa 1942–43; Tunisia 1943; the Aegean 1943–44; Far East 1944–45 and Java 1946.

Squadron roles included artillery-spotting and reconnaissance, support of the White Russians after the First World War, imperial policing in the Middle East, bombing, armed patrol and anti-shipping strikes, and peacekeeping. In chronicling all of these, the author sets the scene and explains the background to why No 47 Sqn was doing what it was doing.

There are three appendices, comprising chronological lists of squadron aircraft types (accompanied by eight selected colour side-profiles of squadron aircraft by Chris Davey); unit bases and a roll of honour. An index completes the package.

The book's presentation is generally clean and unfussy, with illustrations well-reproduced on good-quality paper, but there is an oddity in the layout. The squarish format of the book lends itself to the three-column page grid which has been adopted, but quite often the inner columns (nearest the gutter) are left completely empty, for no apparent reason, wasting a third of a page. "Creative white space" can be effective in small doses, but in this instance it merely makes the reader (well, this reviewer at least) mildly annoyed at the small main-text typeface and the occasional instances of postage-stamp-sized pictures of complete aircraft when they would be much better printed larger.

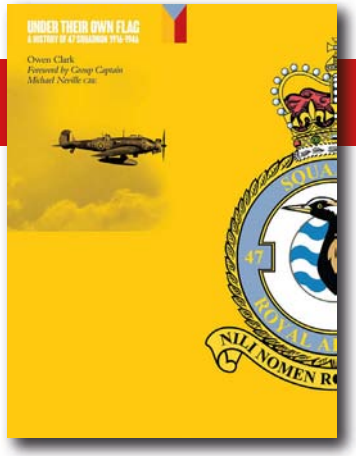
That said, this is a truly worthwhile squadron history — and a sequel is in preparation, looking at the unit's more recent exploits.

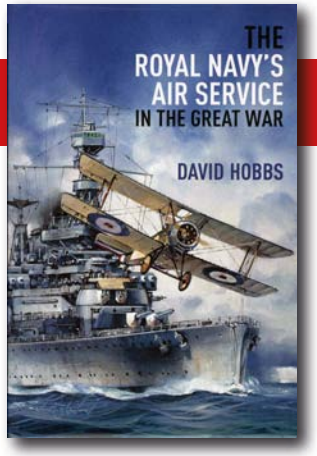
MICK OAKEY

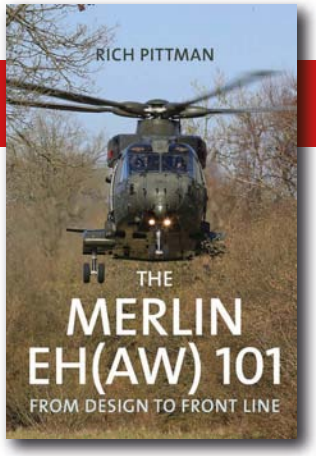
The Royal Navy's Air Service in the Great War

By David Hobbs; Seaforth Publishing, Pen & Sword Books, 47 Church Street, Barnsley S70 2AS (www.seaforthpublishing.com); 6½in x 9½in (165mm x 241mm); hardback; 542 pages; illustrated; £35. SBN 978-1-848323-48-3

A FORMER ROYAL Navy pilot and ex-curator of the Fleet Air Arm Museum, David Hobbs has a well-established reputation for producing authoritative books on RN vessels and British aircraft carriers, so it is good to see him applying his careful research and expertise to the Royal Naval Air Service (RNAS), for which a comprehensive history has been lacking. In 18 chapters he traces the Service's pre-war origins, its growth and organisation, the associated politics and the many and varied aspects of its work in the conflict. In addition to airship and aeroplane operations at sea and ashore, this includes the employment of armoured cars,







trains and tanks. Whole chapters are devoted to the pioneering carrier *Argus* and the Tondern raid and the planned attack on the German High Sea Fleet in harbour.

Perhaps the only thing that lets the book down a little is the poor quality of quite a number of rather fuzzy and contrasty images. This might in part be down to the publisher, but in some cases I suspect that poor copies have been used. Cases in point are the heavily retouched picture of a Gotha bomber on page 362, incorrectly captioned as a "German drawing", and the blurred shot of the D.H.4s of No 5 (Naval) Sqn on page 271.

Appendices provide maps of RNAS airfield sites, a description of RNAS uniform and a list of ships fitted to operate aircraft, and there are notes, a bibliography and a good index. All in all, this is a valuable and authoritative volume, well worth its asking price.

PHILIP JARRETT

The Merlin EH(AW)101: From Design to Front Line

By Rich Pittman; Amberley Publishing, The Hill, Merrywalks, Stroud, Glos GL5 4EP (www.amberley-books.com); 6½in x 9¼in (165mm x 236mm); softback; 96 pages; illustrated; £14.99. ISBN 978-1-445674-36-0

LAVISHLY ILLUSTRATED, this book draws extensively on the archives of Agusta and Westland, now united as Leonardo Helicopters under the ægis of Leonardo SpA (previously Finmeccanica). It sets out to cover the history of the Merlin military helicopter from its design through to the current aircraft in service some 30 years after the first flight of the EH101 prototype on October 9, 1987.

The photographs — colourful, full of action and beautifully reproduced — are very much the strength of this book. The supporting text, while full of information, is rather less satisfying. In places it struggles to flow and, at times (for example in the section headed *Norway – Super SAR!*), reads rather like a sales brochure. When discussing the early years of the aircraft's history, the author omits some important aspects of the story, perhaps owing to his lack of personal involvement with the type's development and the MoD procurement process.

There is no mention in the introductory section of the early studies for a Sea King replacement conducted in the early 1970s under the project name of "Multi-Role Fleet Helicopter (WG27)". Later Feasibility & Pre-Definition studies under the general title "Sea King Replacement" led to the WG34 project. The chapter on design states that "the design criteria included three engines". Actually, the MoD would never express its capability requirements in a form that pre-judged the design solution, as this would hinder competition. The new design's mission capabilities were expressed in terms of a mission endurance of some 5hr, with a certain number of crew, plus search radar, sensors, communication equipment, defensive aids and weapons. This mission profile and attendant equipment and crew requirements indicated, via the feasibility studies, a take-off mass of some 13 tonnes.

There was, however, a mandatory requirement that the new helicopter be compatible with the existing Type 23 Frigate landing-deck and hangar size. This restricted the rotor diameter essentially to that of the existing Sea King. A helicopter 33 per cent heavier than the Sea King, with the same rotor diameter, would require 54 per cent more power to hover under the same conditions. A quick review of available certified engines revealed that three General Electric CT7s providing a cumulative 5,100 h.p. would meet this requirement, compared with the 3,320 h.p. of the two Rolls-Royce Gnomes in the Sea King. The need for three engines emerges from these factors, not from any design criteria placed at the outset by the customer. Of course, by the time a procurement contract was written, the associated

Specification was written around the selected solution and reflected the use of three CT7s.

There is also no mention here that the transition from EH101 to Merlin was associated with significant design changes to the Royal Navy variant. The customer was unhappy with the performance of EH Industries (EHI — a newly-formed joint Agusta-Westland company), feeling that it was not sufficiently independent of its parent company shareholders. The RN Merlin was procured against a modified System Design Specification, which sought the installation and integration of an active dipping-sonar (ADS) system. The original concept for the EH101 was the performance of deep-water fleet protection operations, relocating and prosecuting towed-array frigate detections using primarily passive sonobuoys. There was a shift in emphasis toward littoral (shallow-water) operations and this, together with reduced threat submarine signatures, led to the decision to fit ADS. The Italian Navy, faced with operations in difficult Mediterranean waters, including the Straits of Messina, had recognised this need from the outset. The UK customer sought a new prime contractor to manage this evolution, and a competition was run between Merlin Helicopter Management (BAe and GEC Marconi) and IBM Federal Systems, the latter being awarded the prime contractorship, which subsequently passed to Loral and then Lockheed Martin (ASIC) at Owego, which ultimately performed very well in this role.

There are other minor niggles: the Merlin does not, as suggested on page 10, make extensive use of composite materials in its structure. Also, the benefits of the BERP (British Experimental Rotor Programme) blade come from a combination of features and do not arise solely from the tip shape, although this is the most obvious aspect of its design. Wessex icing-trials activity was substantially complete before the EH101 came on the scene and the knowledge gained from it informed the design, but was not specifically part of the EH101 programme. The very last Wessex trial sortie in this series was regarded as an EH101 support activity. Also, the tail-rotor drive failure on the seventh pre-production airframe mentioned on page 22 did not occur on landing, but earlier in the flight. Directional control was lost during the subsequent "run-on" landing.

The above comments are largely directed towards the first quarter of this book, which despite these points, provides an attractive and comprehensive record of this successful and widely exported helicopter. The EH101/Merlin family has been a considerable success and has become a standard-bearer for the collaborative development of advanced aerospace projects. It has also been a primary factor in the joining of the Agusta and Westland enterprises into Leonardo Helicopters. This is an attractive and interesting book that, in this reviewer's opinion, would have benefited from a greater understanding of the early life of the project.

Dr RON SMITH

B-24 Liberator Handbook Volume 1

By Pavel Türk; Jakab Publishing, available from The Aviation Bookshop, 31–33 Vale Road, Royal Tunbridge Wells, Kent TN1 1BS (www.aviation-bookshop.com); 8¼in x 11½in (210mm x 297mm); hardback; 126 pages, illustrated; £29.99. ISBN 978-8-087350-57-7

ANYONE WITH MORE than a passing interest in the Consolidated B-24 Liberator will remember the late Allan G. Blue's "bible" on the subject, *The B-24 Liberator: A Pictorial History* (Charles Scribner's Sons, 1976). Not surprisingly, the four decades that have followed have expanded our understanding of this iconic bomber, and renowned aviation historian (and

THE AERO HISTORIAN

Edited by Brian Lockstone; 11¾in x 8¼in (297mm x 210mm); 44 pages, illustrated. Published quarterly by the Aviation Historical Society of New Zealand, PO Box 6482, Upper Riccarton, Christchurch 8442, New Zealand; included in AHSNZ subscription (NZ$52 locally, NZ$57 Australia/South Pacific, NZ$70 RoW). Website http://ahsnz.tripod.com.

INEVITABLY THOUGHT OF as "the other *TAH*" by me and my colleagues on *The Aviation Historian's* team, *The Aero Historian* is in fact the recently-renamed journal of the Aviation Historical Society of New Zealand. First published in 1958, it is now an impressive 60 years old; until March 2016 it was known as *Aerolegacy*.

September 2017's issue (Vol 60, No 3) contains seven main articles, the first of which — Errol Martyn's *Flying Home for the Sheep-Shearing* — you may already have read in modified form in this very issue of "our" *TAH*, as we felt it deserved a wider audience. It tells the story of the 1936 England—New Zealand solo flight made by South Island farmer Ernle Clark, a contemporary of Jean Batten. Next up is a detailed account of TEAL Short S.30 ZK-AMC's previously-unpublished 1943 forced alighting in the Tasman Sea following engine trouble; it is followed by a piece about a No 75 (NZ) Sqn Vickers Wellington, and a history of NZ National Airways Corporation's de Havilland Heron operations.

Another British type in antipodean service is chronicled in Tom Singfield's article on Hunting Percival Prince operations with Polynesian Airlines. Finally, two partworks continue — a record of New Zealanders who died in civil air accidents, and the evolution of 1950s–60s RNZAF squadron markings. All-in-all, authoritative and well-presented. **MO**

TAH contributor) Pavel Türk has taken up the challenge of writing an updated version for the 21st Century.

Czech publisher Jakab has produced a hardback book comprising 126 pages of quality paper with first-class photographic reproduction of images obtained by the author from multiple sources, most of which are fresh or of limited previous publication. Scattered throughout the book are reproductions from the Consolidated-Vultee manuals of explanatory drawings, and there is much detail on the many and various defensive armaments carried by the B-24 as technology improved through the war years. All variations described are linked to the serial ranges of the aircraft to which they apply, which is extremely useful.

An appendix covers all the type's models, manufacturers and production blocks with their USAAF serials, and the final pages are a series of colour photographs of the interiors of existing Liberators/PB4Ys. Combine this book and its second volume (currently in preparation) with fellow *TAH* contributor Alan Griffith's *Consolidated Mess* book series with line drawings of multiple B-24s, for Mushroom Model Publications' White Series, and there's very little left that you will ever need to know about the B-24 Liberator, whatever your interest.

That said, there is one "but" — and it's a big one; Jakab has inexplicably produced the book with a Czech-language text only. Nevertheless, it is the photographs that really tell the story.

BOB LIVINGSTONE

Birdflight as the Basis of Aviation

By Otto Lilienthal; American Aeronautical Archives, Markowski International Publishers, Hummelstown, PA 17036, USA (via www.AeronauticalPublishers.com); 6in x 9in (152mm x 229mm); softback; 175 pages, illustrated; US$19.95. ISBN 978-0-938716-58-7; and . . .

Those Magnificent First Flying Machines

By C.B. Hayward (Editor); American Aeronautical Archives, Markowski International Publishers, details as above; 6in x 9in (152mm x 229mm); softback; 351 pages, illustrated; US$19.95. ISBN 978-0-938716-98-3

WE CAN'T ALL be fortunate enough to have original editions of the early classics of aviation literature in our libraries — but, thanks to enterprising individuals, reprints appear every now and then. In the early 2000s American Mike Markowski produced these two volumes, and they are still available.

Otto Lilienthal pioneered hang gliding in the 1890s, making more than 2,000 flights in his primitive monoplane and biplane gliders covered with cotton shirting. In 1899 the first German edition of his book *Bird Flight as the Basis of the Flying Art* appeared, and in 1911 an English-language edition, translated by A.W. Isenthal and including an addendum, was published, and this is the edition used for this reprint. As Lilienthal's only book, this is an essential volume for anyone interested in early aviation or in hang gliding's evolution.

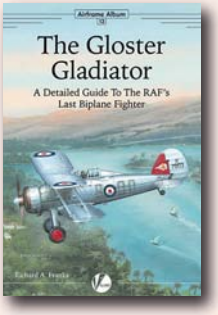
The subject of the second of Markowski's reprints first appeared in various forms in 1909, 1910, 1912 and 1918, under titles including *Practical Aeronautics*, volume four of the *Cyclopedia of Automobile Engineering*, and *Building and Flying an Aeroplane*, the latter comprising a small portion of the book. An exceptional volume for its time, it contains a wealth of information on early aeroplanes and their operation, aero engines, airships, model aeroplanes, propellers and the theory and practice of aviation in the pioneer era. It also includes complete instructions for building Blériot- and Curtiss-type aeroplanes, which the late Mike Beach used when building examples of both types. This is a "must have" for any student of the pioneer years.

PHILIP JARRETT

BOOKS IN BRIEF

A quick round-up of what else is currently available for the aviation history enthusiast

THE GLOSTER GLADIATOR
Richard A. Franks
Valiant Wings Publishing; ISBN 978-0-995777-31-6; £17.95



THIS TWELFTH VOLUME in the *Airframe Album* series, aimed at modellers of World War Two subjects, is the first to focus on a biplane — and what a good choice. The 132-page softback follows the series format with a potted history; a detailed technical description, copiously illustrated with archive photographs, pictures of preserved examples and illustrations from manuals; isometric drawings clearly showing the differences between variants; camouflage and markings; and a step-by-step model-build. Appendices comprise lists of kits, accessories and transfers, and a bibliography. Top-quality reference material. **MO**

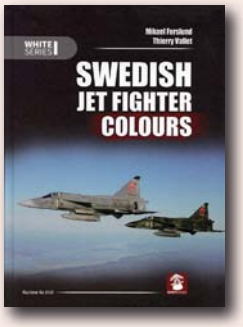
SPITFIRE STORIES
Jacky Hyams
Michael O'Mara Books; ISBN 978-1-782438-16-8; £16.99

PUBLISHED IN PARTNERSHIP with the Imperial War Museum, this lively book departs from the usual pilots' "there I was" accounts by also recording the experiences of groundcrew, designers, engineers, and factory- and office-workers who all, in their own way, contributed to the success of Supermarine's immortal fighter — the backroom people whose efforts and dedication rarely come under the spotlight. Presented in bite-sized helpings and illustrated with two sections of colour- and black-and-white photographs, 20th-Century and World War Two specialist Jacky Hyams's latest aviation hardback is excellent for dipping into when you're looking for something undemanding yet stirring, poignant and surprising. **MO**

BUILDING THE WINGNUT WINGS SOPWITH CAMELS (& LVG C VI)
Ray Rimell
Albatros Productions; ISBN 1-90-5698-62-9; £26

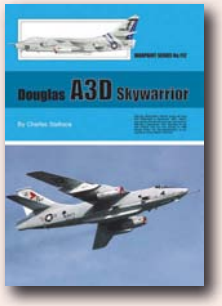
ANOTHER ONE FOR modellers here. For anyone unfamiliar with the Wingnut Wings brand, it offers very-high-quality 1/32nd-scale kits of World War One subjects (and was founded by Great War aficionado and film director Peter Jackson). This 60-page guide is pricey, reflecting its specialist nature, but is jam-packed with fine reference detail and relevant tips on modelling techniques. **MO**

SWEDISH JET FIGHTER COLOURS
Mikael Forslund & Thierry Vallet
Stratus (MMP Books); ISBN 978-8-365281-01-2; £40



A LOGICAL SEQUEL to MMP's excellent *Swedish Fighter Colours 1925–54*, this 272-page A4 hardback details the markings of the nation's jet fighters, from the twin-boomed post-war Saab J 21R to the 21st-Century Gripen, taking in the Vampire, Tunnan, Lansen, Venom, Hunter, Draken and Viggen along the way. Mikael Forslund's text (in sore need of a proper English-language edit) provides a potted history of each type, accompanied by fine profile artworks by Thierry Vallet in a vertically arranged landscape format. Rough around the edges in places, this is nevertheless packed with top-grade info and illustrations. **NS**

DOUGLAS A3D SKYWARRIOR
Charles Stafrace
Guideline Publications; no ISBN recorded; £19



VERY MUCH A supporting actor rather than an A-list star in US Navy service, and nicknamed "The Whale" the A3D Skywarrior carrier-based nuclear/conventional bomber made up for a certain lack of glamour by means of its remarkable longevity: first flown in 1952, it finally departed USN service in 1991 after a last hurrah in Operation *Desert Storm*. By that time it had taken on a variety of other roles, including aerial tanker, reconnaissance and electronic-countermeasures platform. This monograph presents a comprehensive history, generously illustrated with photographs, colour profiles and crisp 1/72nd-scale drawings **MO**

BATTLE OF BRITAIN 1940: The Luftwaffe's "Eagle Attack"
Douglas C. Dildy
Osprey Publishing; ISBN 978-1-472820-57-0; £13.99

THE FIRST IN Osprey's new *Air Campaign* series, this 7½in x 9¾in (190mm x 248mm) soft-back takes an in-depth look at that most covered of aerial conflicts, but largely from the Luftwaffe's perspective. Written by an experienced, authoritative author with an ability to condense a great deal of information into a highly readable narrative, the subject is further illuminated with artworks from Graham Turner and useful diagrams by Adam Tooby. A reference work to keep — and excellent value. **NS**

Lost & Found

***PHILIP JARRETT** explores the lesser-known corners of aviation history, discovering unknown images and rediscovering long-lost details of aircraft, people and events. This time he's calling on aviation film aficionados to help identify a pair of Fokker D VIIs . . .*

BOTH OF THE photographs shown here, of Fokker D VIIs, came from France. I am quite certain they were taken after the First World War, but I have no details whatsoever. I suspect they could well depict aircraft used in a movie, probably in the 1920s or 1930s, but a search in my limited collection of books on the subject provided no enlightenment.

It seems clear that they are two different machines, as the diamond pattern is applied differently on them, and the (incorrect) Maltese-style crosses of their "German" markings are applied in different positions on the port sides of their fuselages, that on the crashed aircraft being much further forward.

The installation of the machine-gun on the intact aircraft is really odd. Normally the D VII's twin Spandaus were mounted on the fuselage top-decking immediately in front of the cockpit, but here we have a single gun, apparently a Lewis with a coolant jacket, mounted within the pilot's reach on the starboard side of the cockpit. Radial-engined biplanes are lined up in the background.

Perhaps there are aviation movie buffs who can determine whether there was a French inter-war movie featuring diamond-bedecked Fokker D VIIs. I would love to know more.

BELOW ***Two photographs of French origin depicting a pair of Fokker D VIIs, doubtless taken after the First World War. The upper image shows the odd Lewis gun mounting on the starboard side of the cockpit; the lower picture appears to show a different machine (the cross is further forward on the fuselage) having come to grief — does anyone know where or when?***

DEAN WINGRIN VIA AUTHOR

snakes in the snow

One of the most succesful jet engines ever designed in the UK, the Armstrong Siddeley (latterly Rolls-Royce) Viper has been used to power numerous types of aircraft since its inception as a limited-life drone powerplant in the early 1950s. **GUY ELLIS** explains how the venerable turbojet is still in operational service — as a New York railroad snowblower

AT MORE THAN 200kt and less than 100ft above the Atlantic Ocean, South Africa's Cape Point starts to fill the windscreen of the jet very fast. The pilot pushes the throttle forward and feels a kick in the back as the Viper engine responds. The Impala trainer soars over the majestic south-western tip of Africa and within seconds the machine is screaming over Cape Town.

Cut to . . . four in the morning on a bitterly cold snowy winter's day in New York, as a Metropolitan Transportation Authority (MTA) maintenance engineer moves an inelegant snow-blower on to the railyard's main line and pushes the button to start the machine's Viper engine. Through the soundproofing he hears that same whine the Impala pilot had heard more than four decades earlier in a sun-filled African sky.

In the immediate aftermath of the Second

MARC A. HERMANN VIA MTA

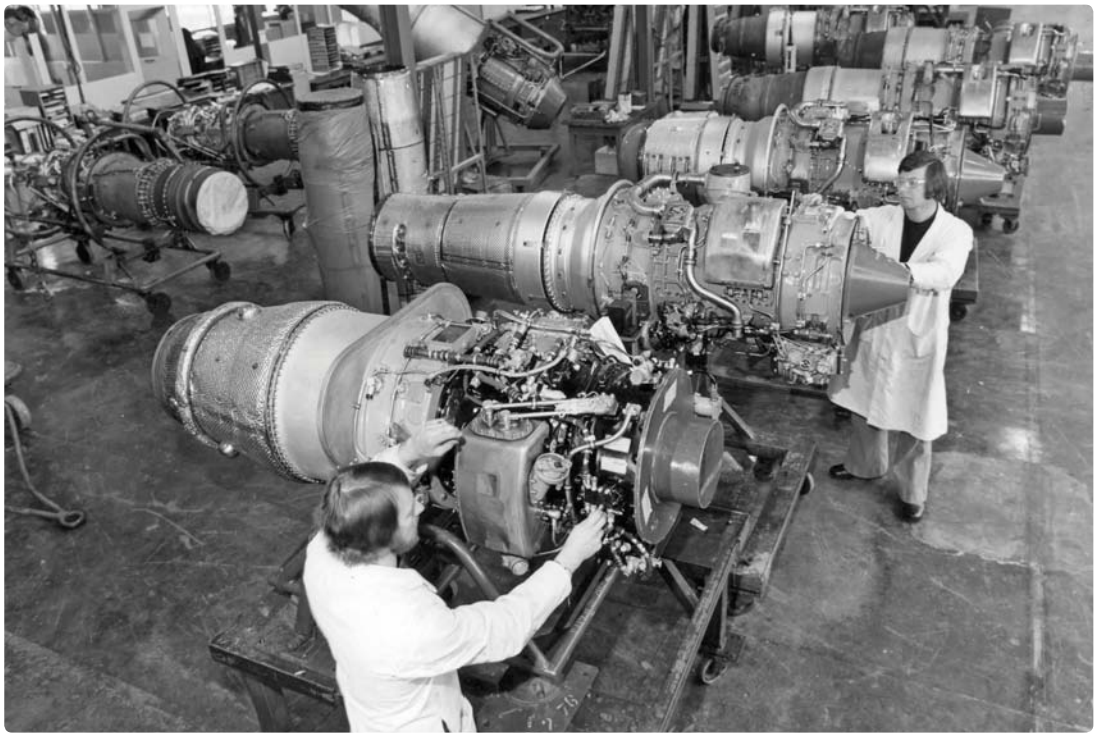
OPPOSITE PAGE, TOP ***Still flying on Viper power in 2018 is Atlas Impala Mk 1 ZU-IMP, originally on strength with the SAAF as "479" and now a popular display item at South African airshows.*** **ABOVE** ***And now for something completely different — an MTA "Hurricane Jet Snow Blower" using its Viper to clear the tracks in January 2014.*** **LEFT** ***An original data plate of one of the Vipers built by Piaggio for the SAAF.*** VIA AUTHOR

World War the British government was keen to take advantage of technological advancements made during the war. Accordingly, a joint missile technology development agreement was signed with Australia, whereby the Australians would provide test facilities and the British would supply the missiles and help to develop a specially-designed unmanned target drone.

Accordingly, British powerplant manufacturer Armstrong Siddeley created the Adder, a short-life (i.e. expendable) turbojet version of its Mamba turboprop, with a total-loss oil system and limited-life components, which was to be fitted into the Australian Government Aircraft Factories (GAF) Jindivik drone. The Adder thus became the forerunner of the Viper series of jet engines. Built to run for only 14hr, the early Vipers' first tests in 1951 promised great things and the basic design was upgraded beyond the wildest dreams of the pioneers of the British jet industry. Although full-scale production of the drone ceased in 1986, the Jindivik was used as the UK's standard target drone until 2004, with some 517, including 15 more built in 1997, ultimately produced.

The Viper was the UK's first post-war attempt at the design and production of an inexpensive, simple turbojet. Mergers and consolidation saw the Viper produced later by Bristol Siddeley and, ultimately, Rolls-Royce. It was also licensed for manufacture in a number of countries: India for the HAL Kiran jet trainer; Romania for the Soko J-22 Orao ground-attack fighter and IAR 99 Șoim advanced trainer, and Yugoslavia for the Soko Galeb trainer range. Others included Italy for the Aermacchi MB.326 trainer, MB.339 ground-attack/trainer aircraft and Piaggio PD.808 business jet/military transport, and Brazil, Australia and South Africa also used the Viper-engined MB.326. In total, more than 5,700 Vipers were built, of which some 334 were made in South Africa.

In the early 1960s the South African Air Force (SAAF) began a process of modernisation, using



TAH ARCHIVE

ABOVE ***The Viper can boast one of the longest production runs of any aero-engine, with thousands being built in Coventry by Armstrong Siddeley, which became part of Bristol Siddeley in 1959, which itself was subsumed into Rolls-Royce in 1966. Production of the highly successful Viper continued despite the shifting corporate backdrop.***

the resulting programme as a springboard for the establishment of an indigenous aircraft industry, the chief instrument of which was the Atlas Aircraft Corporation.

The South African connection

The new company's first venture into manufacturing aircraft under licence was the MB.326, powered by a single Viper 11 Mk 22/1 engine, initially supplied by Piaggio, which built the Viper at its factory at Finale Ligure near Genoa. Subsequently, Atlas began assembling Vipers from Piaggio-supplied kits.

The South African MB.326s were to be known locally as Impalas, and 16 examples were imported for assembly at Ysterplaat in Cape Town in 1966. The first, serial 460, was officially handed over on June 3 that year. Another 30 kits were delivered, after which South Africa's fledgling aviation industry produced a further 105 two-seat Mk 1s and 100 single-seat Impala Mk 2s. Used as a primary jet trainer and light ground-attack fighter, the Impala had a number of advantages over more complex and expensive high-performance jets. Although slower, it could operate from primitive airfields with short runways, and proved itself as a tough and versatile jet aircraft.

Designated MB-326M by the parent company Aermacchi, the Atlas Impala Mk 1 was a Viper-powered two-seat trainer and light ground-attack aircraft built under licence in South Africa. The Mk 1s were given serials in the 460 to 610 range and the single-seat Mk 2s, equivalent to Aermacchi's MB-326K dedicated ground-attacker, were serialled 1000 to 1099.

TAH ARCHIVE

VIA MTA

ABOVE ***Every home should have one — with Viper jet engine pointed towards the tracks despite having no work to do on this occasion, one of the New York Metropolitan Transportation Authority's jet snowblowers trundles out for a photo shoot. The Viper is mounted on an articulated bearing which allows the driver to aim the hot exhaust.***

The Impala also became well known to the general public as the mount of the SAAF's formation aerobatic team, the Silver Falcons, with which it served for three decades. On the type's retirement, 14 aircraft were sold to Brazil, some went to the USA and one or two were acquired by private owners and museums. Most, however, were scrapped, with some of the Viper engines being sold on separately.

A new lease of life

During the summer of 2011, New York's MTA rebuilt three jet-powered snowblowers, the main new feature being the fitting of Vipers to melt the snow, which could be virtually vapourised by the jet's 315°C (600°F) exhaust gases. The MTA's press release on its new equipment highlighted its valuable benefits:

"'If the jets do the job right, all you see is steam coming off the steel' says Peter Hall, foreman of the Maintenance of Way Equipment Shop in North White Plains. 'They produce 2,500lb of thrust, which makes them very good at getting under heavy, wet slush, ice and crusty snow'.

"The Rolls-Royce turbines use half the fuel of the engines they replace — 1950s-vintage General Electric/Westinghouse J57 turbines that were used in [Boeing] B-52 bombers. 'With fuel tanks that hold 1,800 [US] gal, these new jets can run continuously without having to stop to refuel in the middle of a storm', Hall says.

"These turbines produce less smoke, spool up quicker, run cooler and are more reliable than those they replaced. The turbines have directional controls that allow the operator to point the engine's 600°F exhaust straight ahead or sweep from side to side. This specialised self-propelled 30,000lb [13,600kg] rail vehicle can travel at 30 m.p.h. [48km/h] to move from place to place, but slower when the jet is engaged.

"The turbines make [a lot of] noise (imagine an airport runway), so the operator's cab has sound-deadening insulation and ear-protection is required. This is one reason these machines are intended for use in the railyards and remote locations. In densely populated areas, the railroad relies on cold-air snow blowers."

It is extremely important for the MTA to maintain reliable and, above all, safe commuter services for its customers. The MTA's New York City Subway maintains a fleet of snow- and ice-busting equipment which keeps the tracks and, most significantly, the third rail which delivers the power, clear of snow and ice during harsh winter weather. The last of the SAAF's Impalas flew in in November 2005 — but the heart of the little jet lives on with the MTA.

ACKNOWLEDGMENTS *The author would like to thank Emilio Gravano, Giulio Valdonio, Stanislaw Dabrowski, Barbara Buzio, Olie Ericksen, Wynand Breydenbach and Martin Laubsher for their help with this article*

OFF THE BEATEN TRACK

PHOTOGRAPHS BY THE AUTHOR

Ever turned a corner to find something unexpected? The Aviation Historian's *intrepid aeronautical explorer* ***PETER DAVISON*** *investigates the stories behind the oddities that turn up in the most unusual places . . .*

SWITZERLAND IS HOME to a number of "Military Megastores", in which army surplus collides head-on with fashion. Mess tins, fatigues and camping supplies fight for "hangar space", so added atmosphere is provided in one of these outlets in the Gruyère district town of Bulle by this ex-Czech Air Force MiG-21MF, which gives new meaning to the term "underwing stores"!

Built in February 1972 at MMZ Znamya Truda, north-east of Moscow, serial 965304 was one of a total of more than 10,000 MiG-21s built at various locations, the MF variant being given the NATO reporting name *Fishbed-J*. This example served with six Czech Air Force squadrons, the last being *4. základna Taktického Letecktva* (4. zTL) at Čáslav. Retired to České Budějovice in December 1999, it moved almost immediately to its new home in the small town of Bulle, between Fribourg and Montreux in western Switzerland.

The MiG-21MF (M = *Modernizirovannyy* — modernised; F = *Forsirovannyy* — uprated engine) was an improved iteration of the original design, and essentially an export version of the Soviet Air Force's MiG-21SM, although fitted with downgraded avionics. This third-generation MiG-21 variant was powered by a single Tumansky R-13-300 axial-flow turbojet with afterburner, which gave a maximum speed of Mach 2·2 at altitude. The earliest examples were officially first noted in the West in September 1971, when a pair of MiG-21MFs accompanied a delegation to Reims, France.

TOP & ABOVE ***A hard-to-miss attraction, complete with dummy pilot on the wing, is MiG-21MF 965304 at the Military Megastore on Rue de Vevey in Bulle, which may be seen on Google Earth by entering the co-ordinates N46.6148,E7.0499 into the Search box.***

Coming up in future issues:

Stratojets Into Blighty *Boeing B-47 specialists C. Mike Habermehl and Robert Hopkins III take a look at the innovative jet bomber's first series of deployments to the UK in 1953*

The 1938 "Dodgy Dossiers" *Greg Baughen examines the British Air Ministry's evaluation of German air power in 1938, and how it was used as a basis for appeasement at Munich*

The Viscount Comes to America *David H. Stringer opens his three-part series on the American airlines that shook the USA with their choice of the British propliner*

The Aviation Historian®

The modern journal of classic aeroplanes and the history of flying

Be certain to receive each new issue of The Aviation Historian *hot off the presses, by taking out a subscription. It's quick and easy to do. Issue 24 published July 15, 2018*

BACK ISSUES AVAILABLE ***(Issue 1 sold out – but we may reprint!)***

Annual Print Subscription for one year (4 issues): **£44** (UK), **£53** (Europe), **£62** (RoW)
See our website for more details of both print and digital versions:

www.theaviationhistorian.com

TEL 07572 237737 **WRITE** TAH, PO Box 962, Horsham RH12 9PP, UK

Digital edition available via our partners pocketmags.com

Available on the App Store | Available on kindle fire | Available on PC & Mac | Available on BlackBerry | Available on the Google play

WHAT THEY'RE SAYING ABOUT *THE AVIATION HISTORIAN*

"If you can't find something that piques your interest here, your passion is not what you thought it was!" — *Classic Wings* magazine

"Lively and engaging . . . research-rich, factually dense and of academic value" — Minerva Miller, University Librarian, University of London

"Impressive content . . . this is a work of reference to keep" — *NZ Aviation News*

"*The Aviation Historian* is the best English-language aviation history publication available today" — aviation historian Tom Cooper

Find news, film-clips, photos, comments and more on Facebook at *www.facebook.com/The Aviation Historian* and Twitter *@AvHistorian*

compressibility & the P-38 / RAF centenary / fairey rotodyne / ernle clark / jaguars in nigeria / garuda's convair 990s / SO.8000 narval / 748 in africa / lebanon's "hueybombers" / trimotors over the channel / viper snowblower

The Aviation Historian®

The modern journal of classic aeroplanes and the history of flying